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Edited by
J. C. WILLIS, M.A., SC.D., F.R.S.

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COTTON GROWING UNDER IRRIGATION IN THE SUDAN

[The following article has kindly been contributed by Mr. Louis Bluen (Secretary of the Sudan Plantations Syndicate, Limited).—ED.]

AT the battle of Omdurman in the year 1898 the late Lord Kitchener broke the despotic rule instituted by the Mahdi and continued by the Khalifa in the Sudan. For thirteen years the country under their rule had been ravaged by sword, slavery, famine and disease, and the population of at least nine million souls which existed when the Mahdi rule began was reduced to some two or three millions by the time the Khalifa's reign came to an end. The years following the battle of Omdurman were devoted to establishing law and order and improving the lot of the survivors.

The origin of the scheme which led to the development and cultivation of the Gezira Plain is almost a romance.

The idea that cotton could be economically grown in the Sudan was formed in the first instance by a prominent American business man, Leigh Hunt by name, whose patriotic mind conceived the project of relieving the United States of their surplus negro population by returning the American negroes to Africa, their country of origin, and of creating at the same time an enterprise which would yield concrete returns to himself and his associates. With this object in view he visited the Sudan in 1904 and succeeded in obtaining from the Sudan Government a concession for cotton-growing at Zeidab, which is about 180 miles north of Khartoum. In order to develop the concession he came to London, and in conjunction with the late Sir Frederick Eckstein and the latter's partners formed a small company entitled "The Sudan Experimental Plantations Syndicate."

The Syndicate introduced from America a certain number of educated negroes—trained in American schools—such as agriculturalists, mechanics, dairy farmers, electricians, blacksmiths, etc., and the work was carried on for some years; but the experiment as

conceived by Mr. Leigh Hunt did not meet with success, and the negroes had to be shipped back to the States. The Syndicate subsequently was re-organized under the title of the Sudan Plantations Syndicate, and from 1907 onwards the running of the concession, comprising an area of about 10,000 acres, was based upon the utilization of native labour and upon the supply of irrigation by pumps to owners of lands outside the Syndicate's area on mutually profitable terms.

From that date the Syndicate made slow but steady progress. In the meantime the railway, which then terminated at Khartoum, was pushed southward, until in 1910 it reached the town of Wad Medani, which is situated on the Blue Nile at about the centre of the Gezira Plain. This extension—though the motives that induced it were not entirely economic—brought a vast area of land within the possibility of development.

In May, 1910, the Syndicate decided to increase its activities, and after careful study of the possibilities of the various fields available for the purpose, it was agreed that the most suitable place for expansion was on the Gezira Plain. The Gezira Plain is a tract of land of approximately 5,000,000 acres situated between the Blue and White Niles, which meet at Khartoum. Here the annual rainfall amounts to about 15 inches only, and nearly all of it falls in July, August, and September. Thus, taking the figures for Wad Medani for the period 1906 to 1929, the average annual rainfall was 15·4 inches, of which 13·78 inches fell in the three months named above.

The plain is an almost dead flat expanse of dark cotton soil devoid of all vegetation during the hot summer months. The skyline is interrupted only by occasional villages of mud huts and by the banks of the main canals. As far as the eye can see there is nothing but an arid desert of black or reddish-brown soil, the playground of the mirage and of the sand devil. The contrast between this condition of desolation and the vast cotton fields in blossom after irrigation from the Nile is enormous, and testifies eloquently to the skill and perseverance which have brought about such immense changes in the Gezira. The then Managing Director, the late Mr. D. P. MacGillivray, together with Mr. Alexander MacIntyre, now Chairman and Managing Director, paid a visit to the Gezira in 1910, and as a result an agreement was come to between the Syndicate and the Sudan Government providing for the erection of a pumping installation and the initiation of an experimental cotton area at Tayiba of 3,000 acres, of which 1,000 were to be under cotton each year, with a view to ascertaining whether or not cotton could be grown in the Gezira during the time between the middle of July

and the end of March, when the surplus water of the Nile was not required by Egypt. In the event of the success of this experiment, certain concessions on the Gezira Plain were vouchsafed to the Syndicate by the agreement. Lord Kitchener, who was then High Commissioner for Egypt, was deeply interested in the experiment. He visited the Tayiba cultivated areas in 1912 and 1913, and in conjunction with the Sudan Government decided that another pumping station should be installed and a further area of 6,000 acres (2,000 under cotton) developed at Barakat with a view to training the local inhabitants to cultivate under irrigation conditions.

In 1914 the Tayiba experiment was acknowledged to have been successful. The Barakat pumping installation and the area cultivated were developed, and a scheme was arranged by the Irrigation Department for the construction of the Sennar Dam to irrigate an area of 300,000 acres, of which 100,000 acres were to be under cotton.

The agreement with the Government was concluded on terms which were initiated and approved by the late Lord Kitchener, and provided that the Government, the Syndicate, and the native landowner should all contribute to the scheme, and that each should derive benefit in accordance with their respective contributions to the scheme in money and labour. Of the proceeds of the cotton crop the Government was to receive 35 per cent. as compensation for the cost and construction of the Sennar Dam and of the main canals; the tenants' share was to be 40 per cent. for their labour and expense in producing the crop; and the Syndicate was to be entitled to 25 per cent. for its work in connection with the development of the land, minor canalization, buildings and offices, ginning factories, light railways, heavy ploughing tackle, and the entire agricultural supervision of the scheme.

The outstanding feature of this scheme of co-partnership is that no single party to it can make a profit without participation by the others in their respective proportions, so that all three parties are deeply interested in the success of the scheme.

In 1914 the war supervened. The building of the Sennar Dam was delayed, and for many reasons it became very doubtful if it would be at all possible to carry out the project. Nevertheless, it was decided that as far as possible it should be carried out, and for the purpose of training the native population the erection of large pumping units at various points was taken in hand. In 1921 a pumping installation, consisting of two 900-horse-power Diesel engines, was erected at Hag Abdulla, and an area of 6,000 acres (later increased to 7,000 acres) was cultivated under cotton on the main

scheme. In 1923 another pumping installation, consisting of Diesel engines of 3,000 horse-power, was erected at Wad Nau, to cultivate a further area of 11,000 acres, and by 1924 a continuous link of 22,000 acres was under cultivation, extending along the whole frontage of the scheme.

In 1919 money had been raised by the Sudan Government, under British Government guarantee, for the construction of the Sennar Dam, which was completed in 1926. The Dam is two miles in length, and represents an achievement which will stand as a monument to British foresight and engineering skill. In 1926, 80,000 acres were planted under cotton and irrigated both by gravitation water from the Dam and from the Pumping Station.

In 1927, 105,500 acres were brought under cotton cultivation; in 1928, 131,000 acres; and in 1929, 158,500 acres. In each of these years approximately equal areas were under grain and under various leguminous crops. In the current season (1930) the area under cotton is 175,000 acres, under dura 72,000 acres, and under lubia 94,000 acres. One of the advantages of the large areas now under cultivation is that agricultural risks are spread considerably, and indifferent results in one locality are likely to be compensated by satisfactory yields in another.

The land now under irrigation was under native ownership, but owing to the irregular shape of the several plots it was impossible to lay out any irrigation system and at the same time to preserve the original boundaries. The Government accordingly took a long lease from all the owners of the land that was to be brought within the scheme, and paid each owner a fixed annual rental for it. When the irrigation canals had been laid out the applicants for tenancies were allotted, so far as possible, as much of the land owned by them as they and their families could cultivate.

The scheme of cultivation adopted is a three years' rotation on a tenant system, and it is the policy of the Syndicate to encourage the keeping by the tenant of sheep, camels, and other stock to graze off the leguminous crops and to enrich the soil in grazing, to the benefit of the land and of the owners of the stock. Towards the end of May the cotton stalks are cut out and burned, and the white ants finish what is left below in the ground.

The tenant on an average receives a tenancy of 30 acres, of which in each year 10 acres are planted in cotton, 10 acres in grain, fodder, and leguminous crops, and 10 acres remain fallow.

The cotton produced in the Gezira is of the Egyptian type, and thus fetches considerably higher prices than United States cotton.

In the course of the last five completed years fifteen million pounds, worth of Gezira cotton and cotton seed was produced from the successively increased areas in the Gezira, and was marketed in this country. The average yield of lint cotton during those five years was 3·72 kantars per feddan (approximately 375 lb. per acre).

In the season 1929-30 exceptional climatic conditions—namely, heavy rain during the planting period and exceedingly cold weather in December and January—combined to reduce the yield to 2·12 kantars, which is considerably below the average mentioned. Although it is unlikely that the same combination of adverse conditions will again be encountered, except, perhaps, at very long intervals, everything possible is being done to meet such an eventuality should it arise in the future. In this connection an elaborate drainage system to serve most of the low-lying lands has been undertaken by the Sudan Government Irrigation Service, and good progress has already been made with the work, which is being pushed forward vigorously. This drainage system is intended to serve practically all the areas likely to be affected.

During the current season the whole of the cotton crop was planted within the normal sowing dates—*i.e.*, between July 20 and the end of August—and rainfall on the whole was about normal.

It must be realized that the native, in his primitive methods of cultivation, was accustomed to work for about three months only in the year, and to induce him to adopt the arduous work entailed under intensive irrigation conditions it was necessary that a certain amount of the heavy work, such as ploughing, etc., should be done for him. The Syndicate, therefore, provided the very latest type of heavy agricultural machinery to plough the land for the tenant and to ensure that the work was well done.

Some of the other duties of the Syndicate are to supply the tenant with pure strains of seed, to finance him during the cotton-growing season, and to gin and market the crops.

Since its opening in 1926, the Sennar Dam and the complicated canal system dependent upon it have worked well and without any serious hitch, a result for which great credit is due to the irrigation officials of the Sudan Government and to the engineers and staff of the Sudan Plantations Syndicate, who collaborated with them.

Within one month of the opening of the main canal, no less than 75,000 acres had been successfully watered, which was only made possible by the most unremitting exertions on the part of the staffs of the Government and of the Syndicate working together in closest co-operation.

Under the system of irrigation in operation the rights of Egypt are rigidly observed, and the expansion of the area in the Gezira to its present extent is mainly due to the very strict economy in water supply which is exercised. The gradual extensions of the original area have taken place in accordance with the growing demand for additional irrigation from the inhabitants of the adjacent areas, who have been quick to realize the benefits to be derived from the scheme.

Concurrently with the extension of the areas, large numbers of cultivators had to be trained for their work by the Syndicate, and many thousands of miles of subsidiary canalization had to be constructed and equipped with regulators.

The success with which a work of this magnitude was accomplished, and the eagerness with which applications for tenancies came forward, were only made possible by the absolute confidence of the native, inspired by past experience of the fair dealing received from the Government and from the Syndicate and their staffs.

The co-operative arrangement under which the Gezira scheme is worked has amply demonstrated its beneficial effects, not only to the parties chiefly interested, but also to the country generally. The question of food for man and beast, which in the past was precariously dependent on the very limited rainfall and the most primitive methods of cultivation, has, since the introduction of irrigation, been solved by the regular production of grain and fodder crops on one-third of the area. The native, who used to be subjected to famine conditions in a succession of dry years, although in years of heavy rain he could obtain a fair crop, now gets all his food crops free for himself and his family, independently of season and climate. Drinking water, which in the past could only be obtained from wells 70 to 150 feet deep, is now easily available everywhere, and flocks and herds are abundant.

Nearly 20,000 tenants and their families are now settled on the land in the Gezira, representing a population of over 150,000 people engaged in cultivation, and exclusive of those employed in the ginning factories, on light railways, and other occupations incidental to the scheme. These people are treated with consideration, sympathy, and tact by the supervisory staff of the Syndicate, which consists of carefully selected young men, who must be of sterling quality to meet the demands put upon them by the management and by their varied and arduous occupations.

As a result of the irrigation facilities provided by the Sennar Dam, the standard of living of the natives has been raised enormously. Moreover, their health is the special care of the Sudan Government,

which provides dispensaries in charge of native dispensers on each block of 15,000 acres, where first-aid treatment and medicines are readily available. In consequence of this, the reduction which has taken place in some of the most prevalent tropical diseases is most encouraging.

The Syndicate controls the Gezira Seed Farm, which is of great importance as regards the supply of pure seed to the various districts in the Sudan. The Seed Farm also carries on large-scale experiments that have been found successful on a minor scale on the Government's Research Farm, which is provided and run by the Sudan Government, and to the expenses of which the Syndicate makes an annual contribution. There are four main sections—botanical, physiological, pathological, and entomological—and the subjects of experiment at the Research Farm include the prevention and elimination of the diseases and pests to which cotton is subject in the Sudan, crop rotation, the reaction of the cotton plant and of the soil to varying volumes of water, to different sorts of manure, and to various methods of ploughing and planting. Eminent scientists, such as Sir John Russell, Director of the Rothamsted Experimental Station, and Sir John Farmer, formerly Professor of Botany at the Imperial College of Science and Technology, have paid visits to the Research Farm and have made valuable reports and recommendations.

The Sudan Plantations Syndicate is served by a large staff of British inspectors and engineers, of whom hard work is expected in all weathers. They are well housed and their comfort and well-being are constantly under consideration. Opportunities are provided for sports, such as polo, tennis, and horse racing, and there are up-to-date club houses with polo grounds and tennis courts attached. The inspector's duties consist in supervising the work of the native tenants. He is responsible for the work carried out by the tenant during the various stages of the season's cultivation, for the water supply in the area under his control, and for the upkeep of the subsidiary and minor canals. He must watch the progress of the crop and must be constantly on the lookout for any pests that may appear in the plantations. He must keep a wary eye on the first watering, be on the alert for broken canals, and see to the proper regulation of the canal itself. He must also help the tenants to find any extra labour required, and see to it that as far as possible no cotton is wasted by slovenly picking.

On pay day up to 500 tenants may have to be paid by the inspector, which is no easy job, though the natives love it and look on it as an excuse for a holiday and congenial chatter.

For purposes of administration the Gezira areas are at present organized in thirty blocks of approximately 15,000 acres each, and there are three or four British inspectors resident upon each block. In his relations with the native population the inspector has to exercise great patience and tact, and must be able to make allowance for native mentality, which is a mixture of simplicity, shrewdness, and pride.

Preparation of the land for cotton begins in October, when the portion that was fallow in the previous season is broken up by heavy cultivators worked by sets of cable tackle operated by oil engines. During the ensuing months the land is ridged and the channels are cleared out and prepared for taking water. Irrigation water arrives from the canal system by the middle of July, and its supply is carefully regulated by the engineers in charge. As soon as the land is fairly dry after the first watering the natives begin to sow the cotton seed issued to them. Weeds come up with the cotton, and the tenants are kept very busy for a time in destroying them by repeated hoeing. The cotton begins to flower in November, and picking follows about the end of December and continues till about the middle of May.

The food crops, lubia, dura, etc., are sown on land on which cotton was grown in the previous season, and the tenants are expected to sow these as soon as the land is in a fit condition after the first rains. When the food crops have been harvested or eaten off by cattle, the land upon which they were grown is left fallow until the following year.

During the picking season great numbers of outside labourers are required by the tenants for harvesting the crop, and these are attracted from all quarters, especially from the White Nile, by the lure of the money to be earned. They frequently come from districts hundreds of miles distant, and can often be seen trekking along on their way to the Gezira with their wives and babies and household impedimenta. The old lady, whose useful days were assumed to be over, finds herself much sought after and able to earn ample money by picking cotton; the young man and maid also find in it a lucrative means of earning their marriage portion before returning to their own homes; while the old mare camel, whose productivity had ceased owing to poor feeding, again starts to reproduce when fed on succulent fodder. These are some of the things which appeal to the people and attract them.

Enormous sums have been expended on agricultural and other machinery and on building materials, and practically everything

Bringing in Cotton near Kassala Area.

Light Railway Train with Cotton at Main Junction.

has been purchased in Great Britain. Eight large ginning factories have been erected by the Syndicate in the Gezira. They are of a capacity of 80 gins each, are capable of dealing with 1,500 bales of 440 lb. daily, and are equipped with competent staffs of engineers, cotton classifiers, gin carpenters, checkers, and workmen trained to run the gins and baling presses, and thousands of men handle the cotton and cotton seed through their processes at the ginning factories.

In 1929 a Water Agreement was concluded between the British and Egyptian Governments regarding the use and distribution of the waters of the Nile. This agreement provides for the amount of water to be allocated to the Sudan until 1936, when further arrangements may be made, as by that time the Egyptian Government expects to have completed the large works now on hand for the increased preservation of the flood waters of the Nile.

The original agreement between the Sudan Government and the Sudan Plantations Syndicate has been superseded by new agreements, under which the gross area entrusted to the management of the Syndicate has been increased to close on 600,000 acres, subject to certain adjustments in the percentages of profit. One-third of this area, or approximately 195,000 acres, will be under cotton in 1931. In addition, the Kassala Cotton Company, which is a subsidiary of the Syndicate, manages on similar lines, under agreement with the Sudan Government, an area of 61,000 acres adjoining the Syndicate's concession.

The whole area now farmed in the Gezira under the Syndicate's supervision covers an extent of about 100 miles from north to south, and between 20 and 30 miles from east to west. It is traversed throughout its length by the Government's broad-gauge railway and is served by its own light railway system, which forms a network over the whole area and has been laid at a cost of about £170,000, including locomotives and rolling stock.

The foregoing is necessarily but a brief account of the origin and development of Cotton Cultivation by Irrigation in the Gezira Plain, and is intended to give some idea of the work carried on by the Sudan Government and by the Sudan Plantations Syndicate through its British Inspectors, coupled with a short history of the Syndicate itself from its modest beginnings, through its various stages of development, to its present position as an important factor in the production of some of the finest Long Staple Cotton.

Received November, 1930.

SOIL EROSION PROBLEMS OF THE MAKWAPALA AND PORT HERALD EXPERIMENT STATIONS, NYASALAND

BY

H. C. DUCKER.

Cotton Specialist, Nyasaland.

NYASALAND, like other countries having a summer rainy season of the monsoon type, suffers from the torrential nature of such rains. It is probable that soil erosion, due in the main to the inability of the soils to absorb the rains at the rate and in the quantities in which they fall, is the most critical factor affecting the agriculture.

It has been established by observation that a fall of rain of ½ inch can be absorbed by most cultivated soils, but that anything in excess of this, unless the rain falls much more gently than is usual, temporarily causes surface logging and run-off, even early in the rainy season before the subsoil approaches its saturation point. The only way in which such surplus water can escape from the land is by flowing over the surface, and it is when doing this that it does so much damage. When it is considered that falls of 1 inch within half an hour are by no means uncommon, and that upwards of 2 inches in this period have frequently been recorded, it will readily be seen that the amount of water to be disposed of during a rainy season, by run-off, is very considerable, and that its capacity to do damage by removal of the valuable surface soil is correspondingly large. The damage done is directly proportional to the amount of surplus water and the slope of the land that is being eroded.

On uncleared forest land erosion is of little importance, even in areas where the bush fires make a complete sweep of all low-growing vegetation in each dry season. Study of open woodland and savannah forest, typical of the climatic area in which Port Herald and Makwapala are situated, has revealed many points of interest, the principal of which are: (1) Checking of the flow of unabsorbed water, provided mainly by grasses. (2) Greater permeability of the soil as compared with that of cultivated land, due to the high humus content, together with the sponginess caused by the large number of undecayed roots present. (3) Breaking of the force with which the rain falls on the soil by leaves and twigs of the trees and shrubs.

It is, of course, impossible on cultivated land completely to

reproduce the conditions found in the woodland from which such cultivated land was cleared, but study of the forest conditions of high fertility and little or no erosion of soil has given leads to ways in which the problems of cultivated land may be attacked.

Makwapala Experiment Station.

This station was cleared in 1923 from an area of forest typical of a very large area of Nyasaland, and in particular of the plateaux areas of the country. The tree growth consisted of a relatively pure stand of *Brachystegia spp.* interspersed with other species in smaller numbers, mainly *Uapaca kirkiana, Afrormosia angolensis, Parinarium mobola,* and *Pterocarpus angolensis.* The whole area had a dense undergrowth of grasses, mainly Andropogoneæ, of perennial habit, with a few species of Dactyloctenium, Eleusine, and Digitaria.

The soil is a laterized loam derived from the underlying rocks, mainly gneisses and schists, and is for the most part stiffer than its superficially sandy appearance would indicate. Locally the effects of termitaria are to give the land a distinctly clayey nature. It is of interest to note that about sixty of these were broken down when the cultivated area, some sixty acres, was cleared, and many were of considerable size.

During the first two seasons of cultivation erosion gave but little trouble, except on one small part of the area previously cleared by natives. In the third season, however, it acquired such a serious aspect that some remedial measures had to be taken. The rainfall that season was decidedly in excess of normal. The whole station became covered with small channels eroded by the surplus water, and in places where water had collected, owing to the lie of the land, gulleys up to a foot deep had commenced to form. In addition to the serious loss of surface soil, grave difficulties arose owing to growing crops being washed out of the ground. An immediate attempt had to be made to control the surface rush of water over the land. As a preliminary measure the whole station was surveyed and a map prepared showing the contours at 3 feet vertical distance. This showed the general fall on the station to be about 1 in 33.

Three methods were tried of checking the flow of water, as follows:

1. The subdivision of the western third of the station by belts of permanent vegetation planted round the boundaries of all its four fields, which were of five acres each in extent.

2. The subdivision of the centre four fields by large contour ridges at 3 feet vertical distance.

3. The subdivision of the eastern third of the station by drains laid out on the contours in the same way as the ridges in (2), but with a fall of about 1 in 200.

It was found that the simple subdivision of the land by belts of permanent vegetation was insufficient under the Makwapala conditions without making the cultivation areas very narrow and the belts of vegetation correspondingly wide. The idea of using permanent vegetation to check erosion was, however, found of value in controlling scour in the field side drains.

The level ridges proved to be excellent in controlling erosion and causing the deposition of silt, but tended to hold up water above them for such a length of time as to cause damage to the crops. They were admirable in that they offered no difficulties to cultivation, implements and cattle passing over them unhindered, and without damaging the ridges.

The contour drains worked very well, but proved a nuisance in that they were always being damaged by implements and having to be cleared of earth thrown into them. It was obvious that practically they would have to be remade each year.

It was therefore decided to adopt a combination of methods (2) and (3) in the way advocated in U.S.A. publications of graded ridge terraces. The whole station was accordingly contour-ridged in its fifth season. The sixth season, 1929, the grades of the various ridges were corrected where necessary, and a water furrow opened above each ridge terrace with a discharge point at a safe place in a drain or in bush at the end of the ridge.

This season, 1930, the ridges have worked admirably. There is little or no erosion. What small amount of silt is removed by surplus water is caught in the water furrow above each ridge, and the surplus water flows away quietly where it can do no damage. On a few ridges water was held up rather too long owing to the grade being insufficient; this, however, is being corrected during the dry season tillage operations. In general, a fall of about 1 in 400 has been found sufficient to keep the ridge terrace water furrow clear of water without allowing scour.

Where it has been found necessary to have drains on the station, they are being made as wide and shallow as possible and are being kept planted with elephant grass, *Pennisetum purpureum*, to prevent excess scour. In places also where, owing to original faulty alignment of the drain, excess scour was such as to prevent the establishment of the grass, it has been found that small boulders thrown into the bottom of the drain will collect enough silt to enable the grass to strike root.

When this has happened the action is cumulative and the drain tends to silt up. In this connection, therefore, it is as well to note that the blocking of the drain must not be overdone, since it may cause the accumulation of water sufficient to break a ridge terrace. This actually happened in one field at Makwapala last December.

The ridges as now constituted are from 10 to 15 feet wide at their bases and 1½ to 2 feet high at the crest. They are planted with the same crop as the field in general, and little cultivation area is lost other than that occupied by the water furrow on their upper side. They offer no difficulties to implemental cultivation.

Two methods of cultivation on ridge terraced land have been tried out this past season. In one the cultivation ridges (cotton is now grown on the ridge at Makwapala) are run parallel to the ridge terraces, in the other they are run downhill towards them. The improved surface drainage resulting from the latter method appears to be a favourable point.

It may be said that the problem of superficial erosion of the soil has now been solved for the Makwapala conditions. Work must henceforth be directed towards the restoration of the soil to its former state of fertility.

A marked phenomenon following the erosion of the soil from various parts of the station has been the appearance of an "ironstone" pan formed apparently by the oxidation of that part of the subsoil which carries the iron-aluminium compounds set free by the process of laterization. This pan is most marked at low-lying points where seepages appear during the rains, thus indicating that the compounds are in a state of movement within the soil. The pan is not continuous throughout the station, though the presence of the iron-bearing layer can be traced throughout the soils of the area. The degree of induration varies directly with the loss of surface soil, and where this is relatively complete the ground consists of nothing but hard pan through which a plough cannot penetrate. Where little or no loss has occurred the pan is hardly to be found, and inspection pits reveal the presence of a clay-gravel subsoil containing nodules of ironstone.

It is noteworthy that the resistance of the station crops to drought and to various pests and diseases is closely correlated with the degree of pan formation. Certain crops appear able to penetrate the pan and reach water-bearing layers below it. Of these, *Cajanus indicus*, *Canavalia ensiformis*, and *Phaseolus lunatus* are the most important, especially the first named, which flowers and matures a crop four to

five months after the rains have ceased, and remains green and leafy throughout the dry season. Its root system appears to find no obstacle in the laterite pan.

Cotton, on the other hand, is utterly unable to cope with the pan, and behaves perforce as a surface feeder. Shortly after the close of the rains, when the surface soil dries out, cotton ceases to grow, and shows marked signs of drought, with resultant ill effect on the crop. Even before the close of the rains the restricted root system is a source of much trouble, and observations indicate that even the non-indurated pan is effective in restricting root development of this crop. The ill effect of the soil erosion in restricting the depth in which the cotton roots can work is therefore serious, even though no indurated pan results. Attempts to deal with both the indurated and non-indurated pan are in an early stage of their development. It is recognized that the hardening is an aerobic process. In its most obvious form the hardening of the pan layer when exposed by drain digging is a good example. It seems very possible that the loss of organic matter by cultivated soils is a predisposing factor. The process is almost certainly reversible.

Three main lines of attack are being developed: (1) The increase in depth of surface soil by improved cultivation and deeper ploughing; (2) the addition of organic matter to the soil by manuring; (3) the breaking of the pan by the root action of various crops. Special emphasis is being laid on (2) and (3). The large organic content of land under bush is well known, while study of the root systems of the prevailing species of trees round Makwapala (*Brachystegia spp.*) indicates that they are well fitted to break up any pans they encounter. Anti-soil erosion work at Makwapala is therefore developing on lines suggested by what has been observed to happen in the bush—*i.e.*, checking surface erosion and increasing soil permeability to roots and water.

If the good results obtained with cotton this past season have anything to do with the improved conditions provided by the ridge terraced land, the restoration of the Makwapala soil to a condition of reasonable fertility will be a quicker process than was at first thought possible.

Port Herald Experiment Station.

Though the original bush as Port Herald is of the same climatic type as that at Makwapala, the species are decidedly different, this difference apparently being due more to soil than to any other factor. *Adansonia digitata, Cordyla africana, Sterculia spp., Tamarindus*

indicus, *Acacia spp.*, and *Combretum spp.* are typical of the tree growth, while, so far as the grass undergrowth is concerned, Panicaceæ predominate over all else.

The soil is a deep alluvium of false-bedded clays, sands, and gravels, and there is no sharp distinction between soil and subsoil as at Makwapala. Laterization is marked by its absence, and permeability is decidedly good.

The only danger of soil erosion on this station is from accumulations of storm water forming faster than the soil can absorb them, and even then the damage done is more to the growing crops than to the soil. The latter is so deep and the station so level that considerable surface movement can occur without doing much permanent harm. Storm drains protected by elephant grass strips are enough to prevent any serious harm. Three drains with falls of about 1 in 250 take any surface water draining from the cultivated area of the station, and a storm drain on the uphill side of the station protects it from flood water which might flow from neighbouring native gardens. The drains exhibit no scour—in fact, they tend to silt up rather too rapidly, and they rarely discharge for more than a few minutes at a time. The main source of surface water on the station is the run-off from the sites of termitaria. These are clayey and relatively impermeable, but as the land becomes more level and even under cultivation this trouble will diminish.

Received October 1930.

COTTON EXPERIMENTS IN TANGANYIKA TERRITORY UNDER RIVERINE CONDITIONS

BY

A. J. WAKEFIELD,

Senior Agricultural Officer, Tanganyika Territory.

ABOUT one-third of the territory of Tanganyika is drained by the Rufiji River and its four main tributaries, which extend from the Central Railway beyond Dodoma in the north to near Lake Nyasa in the south-west. The main tributary, the Ruaha, joins the Rufiji River at a point about 120 miles from the Indian Ocean, at the western political boundary of the Rufiji District; the river is here almost one mile in width, and is bounded on both banks by low hills carrying a sparse forest growth, the soil being sandy and infertile.

A few miles below this confluence the river flows directly east and narrows into the Pangani Rapids, only 20 yards in width; below them it emerges into the fertile alluvial valley, and continues east to the delta region, where it divides into five great arms. This area is yearly extending seawards, and has great value in its vast mangrove forests and its copra and rice, but is of no importance to the cotton industry. The valley at its western end is about five miles in width, extending to seven miles at its centre, and widening like a fan to forty miles near the delta; it is this fertile area which is of importance to cotton production.

Both north and south of this valley the country consists of elevated sandy lands and hills, of no importance in cotton growing, but that have affected the formation of the flat valley lands, which are divided into uplands and lowlands, although they may have but 3 or 4 feet of difference in elevation. The Mpanganya Agricultural Station of the Department of Agriculture, seventy miles inland, embodies both types of conditions and has an elevation of 107 feet above sea-level. The greater part of the lowlands is to the east of Mpanganya, and consists of a deep alluvial silt soil, areas of which have been cropped continuously for at least fifty years with no signs of soil exhaustion. Much of the lowlands is flooded for ten to twenty days by the annual rise of the river occurring about April, the average rise being about 9 feet above the dry-season level, which itself is some 14 feet below the level of the banks of the uplands.

The uplands occur mainly where the river is bounded on one bank by the older sandy lands, especially in the Western Rufiji; they are very sandy, and are not usually flooded except in such abnormal floods as those of the years 1905 and 1917, when the whole of the valley was under water.

There are 100,000 acres of valley lands highly suitable to cotton, supporting a population of 12,000 families; over 9,000 of these have sown cotton in the present season. Five hundred and six tons of native-grown seed cotton have been produced in one season, and the annual production of non-native cotton, mainly intersown in sisal, is up to 100 tons.

The Rufiji cottons usually head the list as far as the commercial values of the Territory's cotton are concerned: in 1926 the valley uplands cotton was valued in Liverpool at 300 to 325 points on, and that of the lowlands at 325 to 350 points on, the next best being a Bukoba sample at 175 to 225 on.

Endeavour has been made above to give a brief account of the conditions of the area served by the Mpanganya Agricultural Station of the Tanganyika Department of Agriculture, which was started by the Germans about 1912, and was reopened by the Department in 1921. The detailed results of the work and experimentation of the Station are to be found in the Annual Reports of the Department from the year 1922. Here it is our purpose to summarize them briefly, as far as the cotton crop is concerned.

Summary of the Results of Experimentation.

Time of Sowing of Cotton Experiment.—There are two periods of rainfall in the Rufiji District: the short rains, usually in November, and the long rains, normally beginning in February, reaching their heaviest in April, and continuing to the middle of May. The rainfall, however, is very erratic, and hot, dry periods are common in the months of February and March; while a few very heavy downpours occur in January. The following are the average monthly rainfall figures in millimetres over a period of eight years:

Jan.	*Feb.*	*Mar.*	*Apr.*	*May.*	*June.*	*July.*	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*	*Total.*
132·9	70·8	170·9	248·9	56·6	0·7	3·1	5·9	12·4	24·8	65·4	69·6	862·0

The time of sowing of cotton experiment has been carried out on the uplands section of the Station since the year 1922 in $\frac{1}{40}$ acre duplicate plots, with sowings at fortnightly intervals from the first week in

January to the first week in May. The actual optimum dates of sowing for the different years have varied according to the amount and distribution of rainfall, but the dates are confined to a period from the last week in January to the end of February. Cotton sown earlier in January may yield more heavily, but the quality is lower. In the experiments no resowings are made, but the percentage stand is recorded, and this indicates the increase which might be attained by resowing in the usual manner; they further accentuate the rule, which should be followed by all cotton planters of the coastal areas with its erratic rainfall, to plant cotton early in the above optimum period, whether there is rain or not. Full advantage of the rains will then be taken over a large area, and with native plantings the grower is free to sow his food crops when the rains fall, since they are more susceptible to drought periods, and where the rain may occur on one or two days at intervals of ten days or so a good start is imperative.

The months of March and April were formerly regarded as the cotton-planting season, and demonstrations with the above experiments have had great value in correcting this; there are many natives who, by following the advice given as regards the time of sowing, have increased their measured yields from less than 400 lb. to over 800 lb. of seed cotton per acre.

With the extension of the Mpanganya Station to lowland conditions, a similar experiment was started in 1926. The results, as one would expect with silt soils of high moisture content, give an optimum period two months longer than with the upland sandy soils; while cotton sown as early as the beginning of February gives a yield as much as that of the uplands sown at the same time. But most interesting has been the manner in which the progress of the plots has reflected the sensitive nature and the biological conditions of the lowland soils. In 1926 a very heavy downpour, followed by normal rains, resulted in water-logging of soil persisting from January to May; the behaviour of the cotton plants and their appearance indicated a state of soil denitrification not evident on the upland soils; the production of bolls was delayed, and the yield of the earlier-sown plots was uniformly reduced to the level of the last-sown plots. On the contrary, in other years when soil water-logging did not occur the yields were 60 per cent. greater than those of the late-sown cotton.

Such denitrification of silt soils is widely known, and results in a concentration of available plant food in the first inch or so of surface soil, promoting the production of a superficial root system in the

case of rice, which is mainly grown as a rain crop on such soils in the Territory; and this in its turn renders the rice crop particularly vulnerable to any subsequent drought periods. The growing of cotton on rice lands is thus of importance as an aid to the avoidance of denitrification, the long decaying roots of the cotton plant helping the drainage and aeration of such soils. The interplanting of cotton in maturing rice is, in fact, a common practice now in the Rufiji Valley.

Spacing of Cotton Experiment.—The spacing experiment has been conducted over the uplands section of the Station since 1922, and over the lowlands since 1926. The results of the experiment are that a spacing of 3 feet by 18 inches gives the best yields with both kinds of soils, although when the crop is sown late on the lowlands a closer spacing of 2½ feet by 12 inches gives the best result. In every year, with the wider spacings of 3 by 3 feet and 4 by 2 feet to 4 by 4 feet, the yields were less than 50 per cent. of those from the optimum spacing. The experiments have shown most definitely that there is no direct or regular relation between the size of cotton plants and the yield of seed cotton; in fact, there is often an inverse relation—smaller harvests from larger plants. The optimum spacing of 3 feet by 18 inches gives a plant which is sufficiently of the single-stalk type to allow a full development of the fruiting branches, and to permit free access of air and light for normal healthy growth. Native-grown cotton was formerly sown at far too wide a spacing, and this was corrected in one season by the issue to the village headman of painted measuring rods.

As regards the effect of different spacing on the quality of the lint, the British Cotton Industry Research Association, through the Empire Cotton Growing Corporation, examined samples of seed cotton from the experiment of 1926, and reported that there was a slight tendency for the hair weight to decrease as the area per plant increased; the variations in the lint length were only slight, but gave some evidence that the more widely spaced cottons were longest. The Baer diagrams also supported the conclusion that the longer and finer lint was produced from the more widely spaced plants.

Ratooning Experiment.—This has been carried out over the past three years on the uplands section. In 1926 the ratooned cotton yielded 433 lb. of seed cotton per acre as compared with 733 lb. from ordinary cotton; in 1927 the respective yields were 29 and 485 lb. per acre; while in 1928 the yield of ratooned cotton was as low as 10 lb. The chief reason for the failure of ratooning is the dying off of the plants soon after they are cut back at the end of November,

the usual date for the completion of the compulsory uprooting and burning measures. The incidence of insect pests on ratooned as compared with ordinary cotton was in the proportion of 4 : 1 for cotton stainers in the 1927 season, and 1½ : 1 for bollworm; while the equivalent figures for 1926 were 3 : 1 and 2 : 1 respectively. As regards quality, the average length of fibre of the ordinary cotton was 1·2 inches as compared with 1·12 inches for the ratooned cotton; the strength and lustre of the latter was also inferior; and the commercial valuations in Liverpool priced the ordinary cotton at 12·80 and the ratooned cotton at 9·80 pence per pound, with middling American at 9·80 pence.

Topping of Cotton.—Experimentation has definitely shown that no significant increase in yield follows the practice of removing the growing tip at any stage of the cotton plant's growth. This bears out the conclusions reached by the Germans at this Station in pre-war days.

Cotton Variety Trials.—The varieties included in the trials were Webber, Webber 49, Early King, R.M. 53, 68, and 90 from Baghdad, Improved Bancroft, Griffin, Uganda, Uganda 17, Watt's Long Staple, Rustenburg 0, and Foster-Whitehall. The first place over two seasons was taken by Griffin; Improved Bancroft and both Uganda types were outstanding, but the Uganda 17 appeared to be rather weak; the Webber varieties did well in the first season, but later fell off considerably in the exceptionally wet second season of trial. The quality of R.M. 53 was highly regarded by local buyers, but its yield was low.

Cotton Selections.—Selections of ordinary district cotton made by Mr. R. Cecil Wood of the Empire Cotton Growing Corporation at the Mpanganya Station were maintained; and of these, that designated as M cotton was multiplied until there was sufficient seed for the whole of the Western Rufiji, but unfortunately its initial superiority was not maintained, and its place has been taken by another of Mr. Wood's selections known as J cotton. In the growing tests the most consistently outstanding selection was that numbered Mp 9/2, which yielded 2,056 lb. of seed cotton per acre on lowland soil, as compared with 880 lb. from the ordinary district cotton; but in the spinning tests it was found to be very neppy.

The Relation of Cotton to Other Crops.—The importance of cotton to the large rice-growing areas of the Rufiji Valley has already been indicated. Experiments have been carried out at Mpanganya to obtain comparative data of cash returns of rice sown as a pure crop, and rice intersown with cotton; the former gave 1,639 lb. of paddy

at a gross return of Shs. 149 per acre, while where cotton was planted between the lines of flowering rice the yields were 1,298 lb. of rice and 597 lb. of seed cotton, the total return from the intersown crops being Shs. 163 per acre. There is also the value of the cover effect of the cotton crop, which by leaving the land clean at the end of the season appreciably reduces the labour costs for the preparation of the land in the following year.

It is still difficult to persuade natives to plant cotton in the Rufiji District; but it has been found easier to do so where a system of interplanting with other crops is encouraged. For this the maxim is insisted upon that shaded cotton is no cotton; and keeping the characteristics of the various grain and other crops in mind, successful combinations have been worked out at the Mpanganya Station, which in practice have given yields of cotton little below those obtained from pure crops, together with yields of grain superior to the yields from such crops grown in the native fashion, which is wasteful of land and of energy. The method attains two objects—namely, the lining out and correct spacing of food crops, which results in increased yields, and the extension of the cotton crop. The most important combination, after that of cotton with rice, is the planting of cotton between the lines of *ripening* maize spaced at 3 feet by 18 inches; a month or so after sowing the cotton the maize is harvested, and the stalks are cut and used as an effective mulch for the succeeding cotton. With gram and Tepary bean, cotton can be sown either at the same time or after the pulse crop. The tall, coarse-growing native sorghums are unsuitable; but cotton can be intersown with short finer types, such as Dwarf Hegari and Feterita, introduced from the Sudan. Good results are also obtained by planting cassava slips between the lines of cotton at any period of its growth.

By means of instruction and demonstration on these lines many natives have been persuaded to grow cotton who had neglected it in the past; and after the disastrous effects of the fall in cotton prices in 1926, it is doubtful if cotton growing in the Rufiji would have recovered to its present extent without the above labour-saving methods of production, which, moreover, lead to a more organized cleanly farming and tend to a rotation where formerly the same crop was grown year after year on the same soil. It must be realized that the native of this district is amongst the laziest on the coast; the fertility of his land makes him so, and in cotton we have a serviceable instrument not only for bettering his economic position, but also for bringing about an improvement in the general agriculture of the district.

SUMMARY OF CONTENTS.

General conditions served by the Mpanganya Agricultural Station of the Department of Agriculture, Tanganyika Territory. Results of experimentation. Time of sowing of cotton: the optimum period from the end of January to the end of February for the valley uplands, and two months longer for the lowlands. Value of the cotton crop in aerating lowland soils and its importance to rice growing. Spacing of cotton: optimum spacing at 3 feet by 18 inches; effect of spacing on the quality of lint. Ratooning: decreased yields and poorer quality. Topping of cotton of no advantage. Cotton varieties and selections. The relation of cotton to other crops, with especial regard to interplanting of cotton with food crops.

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NOTE BY ED.—In regard to the recent discussion upon neppiness at the Cotton Conference (*cf.* vol. vii, p. 262, and bottom of p. 264), the facts recorded under Cotton Selections, p. 20 above, seem to have some bearing upon the question.

AMERICAN COTTON IN THE PUNJAB

In connection with the article on the above subject by Mr. W. Roberts, appearing in the July issue of this journal, the following note has been received from Mr. D. Milne, C.I.E., Director of Agriculture, Punjab:

"I have read with interest Mr. Roberts' article on the introduction of American cotton in the Punjab which appeared in Vol. VII., No. 3, July, 1930, issue of The Empire Cotton Growing Review, but as the person who evolved the American and Desi cotton strains which have attracted attention in the Punjab in the past twenty years, including 4F, 285F, and 289F Americans, I do not think that Mr. Roberts has done full justice to the fact that the spread of American cottons in the Punjab is due fundamentally to the evolution of 4F. This cotton was a hardy type which in the climatic conditions of the Punjab plains, and the rough and ready cultivation given to cotton crops by the ordinary farmers there, gave consistently for many years after it was issued a much better money return than any other cotton, foreign or indigenous, available to them.

"1. Soon after I joined the Department in 1907 I made a collection of cottons, including strains from nearly all the well-known cotton-growing countries, such as Egypt, America, Africa, etc., and the most prominent strains from other provinces of India. I also made a very complete collection of the varieties found in the crop mixtures in different parts of the Punjab, and soon had many improved strains of indigenous cottons available. There was little demand for indigenous strains, however, in view of the results which farmers got from 4F, and from the moment it was issued it spread with as great rapidity as we could supply the seed, despite the fact that we had practically no staff in the districts in those days for propaganda work. It was obtained by farmers unofficially from my area before it was handed over to Mr. Roberts for further tests, and to my knowledge it was grown on many thousands of acres before it was given out by Mr. Roberts from the Government farm.

"2. The American cottons which I found on the farm when I took up cotton work in 1907 were, as I proved later, largely made up of a *mixture* of types, many of which failed as a rule to give a fair crop in the conditions in which they were grown.

"3. In certain years of late, 4F has been afflicted with a mysterious disease which suddenly appears in the months of September or October, and which results in a miserable yield of kapas with lint which can only be described as trash. My own view for years now has been that the plants become afflicted with a sort of 'heat stroke,' due to conditions arising in September or early October in which the plants transpire more moisture than the roots can take in. In these months the plants are in full leaf and flower and lint is forming; therefore a sufficient water-supply to meet requirements is of special importance at that time. I have a great deal of evidence to support the view above mentioned, but certain other people have different theories, and as the question is one of vital importance to cotton growers here, I formed a committee in 1928, which included an Agriculturist, an Agricultural Chemist, a Plant Physiologist, a Mycologist, and an Entomologist, to look into the cause of the trouble. That committee is steadily collecting information, and we hope that we shall have an irrefutable decision on the matter soon.

"4. Since I gave it out, 4F has undoubtedly deteriorated considerably in its power of resistance to the conditions which cause this mysterious disease, and I hope that a reselection from the old stock at Lyallpur, which will be more resistant, will be available to farmers presently. That hope is not without foundation, as a number of very promising selections from that stock are now on the farms of the Cotton Research Botanist and the Professor of Agriculture at Lyallpur.

"5. I agree that the cotton auctions which were initiated by Mr. Milligan in 1908 and continued and developed by Mr. Roberts when he was head of the Agricultural Section were very useful, but I feel we shall go wrong if we imagine that they were the cause of the spread of American cotton in the Punjab or that a revival of cotton auctions will do anything to increase the area under American cotton here, if we do not have selections of these cottons more profitable than the indigenous varieties to place in the hands of the ordinary zemindar. In this connection I may make the following quotation from Mr. Milligan, D.D.A.'s report in the Report on the Operations of the Department of Agriculture for the year ending June 30, 1908:

"'It is estimated that the growing of the American variety represented a loss of Rs. 6-7-0 per killa (one acre approximately) as compared with deshi.'

"In the same report he writes:

"'We have refused to guarantee anything about the water-supply, which I consider perhaps the best move of all, thus getting rid of

what was certainly an inducement to grow, if not an actual bounty on American cotton. I have put up a scheme for the disposal of the produce by auction, which I hope will be sanctioned, as I am sure that better prices will be thus obtained. The scheme should rest on a commercial basis, and should stand or fall on its own merits. Owing to the backwardness of the work on cotton at the Lyallpur station, the true policy seems to be to avoid sudden expansion until the selections, crossings, etc., have produced some definite result. We are quite prepared to advance to a large area when a type more suitable to the country has been produced.'

"6. Again, in the case of my 8A wheat, for example, we have had no auctions, and although it was given out in 1919 when we still had practically no propaganda staff, it has spread with great rapidity from that year. As a matter of fact it is now growing on over two million acres, and still spreading rapidly. The fact is that farmers here are as keen as can be on getting hold of anything which will improve their incomes.

"7. Unfortunately, there was only one farm in the Department when I began my cotton work at Lyallpur, but as Government farms have largely increased in numbers the cottons evolved in the Botanical Section have been tested on all those farms which are in any way suitable for such tests, and this policy has continued up to date. I may add that one of the reasons why I inserted in my Five Years' Programme a large increase in the number of Government farms—many of which we have now got—was to allow of new varieties of cotton, wheat, sugar-cane, etc., being tested in different localities and conditions under departmental staffs who have had some training in science, experience having shown me that it was practically impossible to get reliable data from ordinary farms.

"8. There are a number of other points in Mr. Roberts' article which seem to me to give impressions that I cannot agree with, but I need not deal with them here, as I hope to write up a history of my cotton work at a not very distant date."

JEALOTT'S HILL

AN EMPIRE RESEARCH STATION

[Adapted from an article kindly prepared for us by Imperial Chemical Industries.—Ed.]

THE future prosperity of agriculture depends largely upon the accumulation of knowledge, so applied that the many causes of depression may be traced to their roots and overcome, and it is with this aim that Imperial Chemical Industries, Ltd., have established the Agricultural Research Station at Jealott's Hill, where the fertilizer problems of the world are studied, and for some of which solutions are already being brought to light. Not in competition, but allied with the older stations, Jealott's Hill stands for progress in the never ending struggle to feed the population of the world.

Imperial Chemical Industries, Ltd., regard the fertilizer side of their business, already of the greatest importance, as one which will steadily increase in magnitude. The synthetic nitrogen factory at Billingham is adding many thousands of tons a year to the supplies of nitrogen fertilizers, and although much knowledge already exists with respect to their use it is quite obvious that there is still much more to be gained.

Sir John Russell has said that " Perhaps the best lesson taught by experiments . . . is the absolute necessity for leaving the agricultural investigator to get on with his work in peace, putting no pressure on him for immediate results, requiring only that he shall conscientiously and diligently seek the truth." That is the policy of Jealott's Hill.

Naturally the great part of the open-air work at the Station is concerned with British agriculture under English climatic conditions, but the chemists and statisticians are daily engaged in examining the problems submitted by the Dominions and foreign countries.

Home Research.—Much of the outside experimental work on the farm is devoted to the direct study of fertilizers. Special attention is paid to the functions of nitrogen in influencing growth and yield. Fresh discoveries are keenly examined, and the new granular concentrated complete fertilizers, now beginning to be used by the home farmer, represent one instance of the fruits of the research work.

The use of fertilizers on grassland—a practice now quickly gaining ground in the British Isles, on the Continent, and among overseas countries, perhaps most rapidly in New Zealand—brings many fresh problems, as well as immediate advantages, in its train. These are being carefully explored, and a number of experiments are being conducted on the preservation and artificial drying of young protein-rich grass.

An Economics section, centred at the Station, has charge of the accounts at a number of farms in the country where intensive methods are being tested. Elaborate costings records are kept, and already some striking results have been reflected in the figures obtained.

The problems of animal nutrition, being closely bound up with all farming operations, are also under investigation, and a special department exists for studying the composition and digestibility of every kind of herbage and farm-produced feeding stuff.

All the field trials at, or controlled from, Jealott's Hill are carried out in accordance with the methods evolved by Dr. R. A. Fisher of Rothamsted, whose work on the statistical analysis of fertilizer experiments is recognized as being far in advance of any other.

Jealott's Hill is a very important link in a chain of research organizations which embraces the world. In India, in all the Dominions, and in many foreign countries there are technical agricultural officers, working in close co-operation with the Station, who are responsible for the conduct of all experiments and trials.

India and the Dominions.—In India close liaison is maintained with the official agricultural departments, particular attention being given to problems arising from the cultivation of rice, cotton and tobacco. Trials in Canada include a full enquiry into the possibilities of intensive grassland management in British Columbia, and the effect of fertilizers on the various soils which occur in the other provinces of the Dominion.

In South Africa the agricultural experts of the great industrial company, African Explosives and Industries, Ltd., whose headquarters are at Johannesburg, have powerful allies in the Jealott's Hill staff. Their experimental farms at Umbogintwini, Natal, and at Somerset West in the Cape Province are fruitful sources of information when the peculiar difficulties of South African agriculture are being studied. The grassland of the Union reacts in the normal manner, though the arable land is capricious in its response to fertilizers. Sir Frederick Keeble, the Controller of Agricultural Research for Imperial Chemical Industries, has recently completed a six-months tour of preliminary investigation in the Union, and has pointed out several promising

avenues of attack on these problems. Hitherto the view has been taken that the use of fertilizers in South Africa on arable crops is uneconomic. On grassland, drought has hitherto been regarded as the factor which sets a limit on growth. The economy of manuring arable crops awaits renewed investigation, but in Sir Frederick's opinion it is possible that the chief cause of grassland poverty in the Union is not lack of resistance to drought, but mineral deficiency. The gate has now been opened and the field lies ready for exploration.

In Australia, experiments are at present chiefly devoted to ascertaining the effect of fertilizers, and especially nitrogenous fertilizers, on wheat, rice, and grassland. In New Zealand, grassland forms, as is natural, the main plank in the research platform. In co-operation with the Department of Agriculture the chief grassland officer of Imperial Chemical Industries, Ltd., has recently completed two years of observation and experiment on the grasslands of both islands.

Colonies, Mandated Territories and Foreign Countries.—In the colonies and mandated territories the work of agricultural research is being pushed forward rapidly. Experiments are in progress on cacao, sugar cane, and coconuts in the West Indies; on bananas, citrus, vines, tobacco, and many other crops in Palestine; on coffee in Kenya and Tanganyika, and, in conjunction with the various Departments of Agriculture, on a number of crops in Uganda, Nyasaland, Northern Rhodesia and Sierra Leone. Cotton experiments have been planned on a large scale in Egypt and the Anglo-Egyptian Sudan, and the work here will increase in importance as time goes on.

Technical staffs are maintained in many foreign countries. In China the company has its own experimental grounds at Shanghai, where, together with other centres throughout China and Manchuria, a careful survey is being made of the effect of fertilizers on rice, maize, wheat, sugar cane, jute, cotton and mulberry. Agricultural education holds a high place in Japan, and there is little need to tell the farmer that the use of fertilizers pays. Concentrated fertilizers are now entering this field, and their effect on all the principal crops is the subject of widespread trials. In Siam, experiments on the manuring of rice are proceeding in co-operation with the Siamese Ministry of Agriculture.

Space admits no reference to the many other countries in which the agricultural staff of Imperial Chemical Industries directs the experimental work conducted by its allies. From whatever country or source information is obtained it is transmitted to Jealott's Hill, where observations are recorded and results subjected to statistical

analysis. The knowledge thus widely gathered is no less widely spread abroad.

Finality is never achieved. Each new result suggests another line of investigation which, in turn, opens up fresh country. It is the accumulated knowledge of years which ultimately brings profit to the farmers of the world, and by every means in their power the research workers at Jealott's Hill are striving for the object for which the station was founded—a more prosperous agriculture throughout the Empire.

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COTTON PRICE STABILIZATION

BY

C. H. BROWN.

THE principal difficulty in considering all questions of price stability is that the movements of the price of each commodity consist of two parts—*i.e.*, one due to general changes in prices, and the other due to the price movement of the particular commodity considered. Cotton is no exception, and though for some time there have been discussions on the desirability, or otherwise, of stabilizing cotton prices, the question is brought very much more to the fore when a general fall in commodity prices adds its effect to that of previous changes. Unfortunately, however, the present general fall in prices has its roots in causes so much outside the range of the cotton trade as such, that any attempt at present to stabilize cotton prices by themselves is bound to be overwhelmed by the general price fall. The Federal Farm Board in America, who tried to stabilize American cotton at 16 cents a pound, and the Egyptian Government, who for a time took all Uppers offered at 19 dollars a kantar and all Sakel at 27, have both had cause to realize this. That the general price fall overwhelmed them both does not prove that cotton price stabilization is either impossible or undesirable, but it does show that the attempt is hopeless until general commodity prices have first been stabilized. This, of course, is a question outside the cotton range altogether, but that is perhaps all the more reason why it should be understood first. The index of all wholesale commodity prices, 1926 being taken as 100, has fallen almost unceasingly in the last two years, and is now (October, 1930) down to 82. The cause of this, since it brings in its train a large part of the economic difficulty from which the world as a whole is suffering, is the subject of acute controversy, but there is a general agreement that the present credit and gold reserve policies of the central banks of the world are not sufficiently elastic to finance an increased production except at lower prices. As a corollary, the finance of increasing production and consumption at stable prices requires a greater measure of co-operation for credit expansion between the principal central banks than has been achieved. The problem, however, is at the moment getting so much limelight that its solution in the near future is not impossible; the League of Nations has in the last year

published a note on the subject, and the British Government has its Macmillan Committee on Finance and Industry. Although, therefore, for the moment the cotton trade can only wait and hope while its prices are dominated by forces beyond its control, the time may come when cotton price stabilization schemes can be made or marred by cotton factors only, and their discussion at this stage may not therefore be entirely irrelevant.

The curse of cotton prices in the past, before the present price fall dominated the situation, was the pendulum rise and fall due to the lack of concerted prevision. The argument of the cotton grower at planting time was: "Prices are high—I must grow more cotton and take advantage of them." But unfortunately every individual farmer thought likewise, and so large a crop ensued that at picking time prices were not high. Then, of course, the argument ran: "I lost on cotton last year, and in any case prices are low now; I must grow less cotton." And again all thought alike, and so the vicious circle went on, and may at any time begin again if general world prices settle down. The speculative element in the cotton market, of course, tends, for its own advantage, to exaggerate price changes that already exist. The fatal flaw is, obviously, the inability of the farmer to know at planting time what prices will be at picking time, and it is only the latter price that is really of any value to him. The lack of such foreknowledge has often in the past led to the absurdity that a large crop has been sold at a lower total price.

It is this element of foreknowledge of what price he will be able to sell at that stabilization schemes attempt to supply. In the long run cotton prices must, of course, follow the law of supply and demand, but in the case of a yearly crop, so stabilizers argue, a yearly adjustment should be all that is necessary, and if this took place at the time of the growing season, before the planting arrangements were made, growers could work in much greater confidence, and their interests as a body would all be in the direction of increasing yields per acre.

Stabilization, of course, has its opponents on principle, the principle that the best thing to do with industry is always to leave it alone. It also has its advocates on principle, the principle in this case being that price stabilization should always be at a higher price than that ruling. That the former class are often speculators and the latter class growers may suggest that the last word in the general interest has not yet been said. It is possible that in future the necessity of the planter's foreknowledge of his harvesting price

will become so generally recognized that further experiments in stabilization will be inevitable.

Any attempt at price stabilization of the main crops which determine world cotton prices is, of course, a different proposition, though only in scale and in the psychological reactions involved. The size of the interests concerned makes it improbable that any such operations will be attempted for some time to come, yet the writer is so convinced of the ultimate desirability of some such price control scheme that the issues involved and the measures most likely to command success seem worth discussing.

The main essential to success appears to be that the nettle should be grasped boldly. In the smaller Empire crops the non-existence of any vested interests allows any Government that wishes to do so to fix cotton prices fairly easily. The more vested interests become involved, the more necessary it is to get the general backing of all disinterested parties before starting out on stabilization. A firm and consistent policy is then necessary in order to eliminate as soon as possible such speculative interests as stand to gain by price changes.

Control of the actual cotton is a necessity for stabilization, but this control can be exercised at any stage through which all cotton must pass. A control of price of all cotton ginned is possible, leaving exporters uncontrolled, or *vice versa.* If only a general stabilization is aimed at through a physical control of a part only of the crop, as in both the Federal Farm Board and Egyptian Government attempts, it would appear to be only fair to the interests handling the uncontrolled proportion that selling prices should be announced simultaneously with buying prices. In the absence of such an announcement "the market" almost inevitably interprets the existence of controlled stocks as a bear factor. Where there is complete control, of course, "the market" does not exist, and such control, though probably requiring a more determined plunge at the outset, is likely to be much simpler in final operation than a controlled part of the crop coexisting with a free market. In a partially-controlled market, also, the possibility of large losses to the authorities is always present; in a fully controlled market there can be no gains or losses in the long run. The simplest scheme is one in which the Government offers to be the sole buyer of all cotton at a fixed price for each variety and grade. A carry-over of each type is also required and should be easily available after the first year's operations. From then onwards the matter is simple. If a variety or grade has been priced too low in any one year, the demand from consumers will be greater than the supply. This demand is then met from the carry-over, while demand

is reduced and supply increased for the following year by raising the price of that type. If the demand be less than the supply, the price will be lowered. The essence of such a scheme is that the same factors of ultimate spinners' demand and basic cost of production to the grower would determine the price of each variety and grade in the long run precisely as they do now, but adjustments would be made year by year instead of day by day. Is such a system ever likely to be put into operation? Certainly not at present, perhaps not for a long period of time, and yet can it be reasonably doubted that eventually some such conscious organization of marketing must come? The Canadian Wheat Pool, the United States Federal Farm Board and Co-operatives, and the Lancashire Cotton Corporation are all signs of the times. For cotton growers and users alike it is the form of more organized control which can now most profitably be discussed, rather than whether or not such control will come.

In connection with this article it may not be amiss to refer to the editorial upon p. 1 of Vol. IV., 1927 (Low Prices for Cotton). In the case of a crop like "Egyptian" cotton, which is practically all produced in one country, control is comparatively easy; but in the case of "American," produced as it is under so many different flags, a good deal of delicate international conference and agreement will have to be put through before a really efficient control can be established. In the article referred to it was pointed out that the actual position may easily, as it did in 1926, become a cruel satire upon our existing methods of production and distribution, and it is clear that great improvements are desirable.

Much consideration of such things as the Dutch culture system in the East Indies, the valorization of coffee in Brazil, and its effects on other countries, the capture of Ceylon's trade in cinchona by the Dutch (owing to more scientific treatment), the recent history of rubber and of coconuts, and very many other phenomena that might be mentioned, will be necessary in devising control systems. Mr. Brown's paper forms a contribution to the discussion that is now going on upon this subject, and we shall be glad to consider other opinions also. An interesting contribution has been made by Dr. Martin Leake in his articles on Rationalization in *Tropical Agriculture*, August-October, 1930.—ED.

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FOLK-LORE FRAGMENTS—III

BY

J. C. MAY.

The Native Commissioner had just completed a tour of Swewe's villages at the close of the cotton harvest. Prices had been low, but by no means as low as they would have been had not a fatherly British Cotton Growing Association concluded an agreement with the local Government, under the terms of which the profits in years of high prices were devoted to the payment of something over the equivalent of the world's price in times of low values. So everyone was fairly happy, and the N.C. hoped that his little lecture on thrift based on this policy would sink in.

The day had ended with the hearing of a case in which it had been abundantly proved that one of Swewe's villagers, Mchenjera, had collected a good deal of his neighbours' cotton and sold it as his own. A discreet cough in the shadows surrounding the small fire before which the N.C. was sitting in his camp told him that the old Chief had decided that as he had finished his coffee he should be ready for one of the chats about life in general which both of them so much enjoyed.

An attendant placed a low stool by the fireside, and Swewe, on being invited, sat himself down, dismissed the attendant, and lighted the cigarette the N.C. offered.

"Bwana, you were quite right regarding Mchenjera. He is well named; as you said, Bwana, he is too clever. The village will not let him forget the new name you have given him—Kalulu Woipa, the bad rabbit."

"Tell me another rabbit story, Swewe," answered the N.C. "You know how I enjoy your stories."

"Do you know the one of the Rabbit and the Lion, Bwana?" asked Swewe.

"I do not think so, and I have never been able to discover why in all fables the rabbit is held to be so clever and cunning."

"Oh, but he is," replied Swewe. "Judge if he is not by this story.

"Long, long ago the Rabbit said to himself, 'These men who have just arrived in our country seem to possess much wealth. What can I exchange with them for some of the things I want so badly? I will kill some game and sell it to them.'

"So he dug a game pit and carried away all the earth he dug out so as to leave no traces. He covered the mouth of the pit carefully with thin bamboos, and sprinkled leaves and grass on them. When all was ready he stuck his axe up in the fork of a tree just over the pit by springing up in the air and landing just at the side of the pit. He then sat down and started to cry 'Amai, Amai—Mother, Mother.' A Bushbuck, hearing his cries, turned aside and came up to ask him what was the matter. The Rabbit replied, 'A Reed-buck came along, and to tease me stuck my axe up in that tree, and I cannot reach it.' 'I will get it down,' said the Bushbuck, and stepping forward fell into the game pit. Then the Rabbit gave a great jump, seized his axe and killed the Bushbuck. Running to the nearest village, he bargained with the men he found there for four yards of calico for the Bushbuck's carcase. The men came and carried away the Bushbuck, and the Rabbit removed all traces of their spoor, re-covered the game pit, hung up his axe, and thinking his scheme a most excellent one, started to cry again 'Amai, Amai.' Presently, when he was getting very hoarse with much calling, along came a Lion.

"'Why do you cry, Rabbit?' he asked. Then the Rabbit told his story of the axe, and the Lion, in reaching up for it, fell into the game pit. But the Rabbit had dug the pit for small animals, and the Lion sprang out and seized the Rabbit and shook him, and said, 'Now I will kill you, for you thought you would kill me.'

"'Oh, great Chief, spare me, spare me. I shall be no use to you when I am dead, but living I can act as nursemaid to your children.'

"To this the Lion, after consideration, agreed, and they went together to the Lion's village, and he commanded the Rabbit to look after his two children, for his wife was dead.

"After some time the Rabbit became tired with always having to look after the Lion's cubs; if one was good the other would be wicked, and the Lion beat him when he came home and found that the cubs had damaged things. If one remained still, the other would wander off and had to be fetched back. So one day when the more troublesome cub wandered off the Rabbit caught him and killed him with his axe and threw his body into the river.

"When the Lion came home he asked to see his children, but the Rabbit said, 'They are tired and in bed,' and went into the darkness at the back of the cave, and lifted up the cub that remained and said, 'Here is the one,' then holding up the cub a second time he said, 'Here is the other; but they must sleep.' The Lion had eaten a large meal and felt sleepy himself, and was satisfied that both the cubs were well.

"Next day the cub that remained wished to play with his brother, and not knowing that he was dead, said to the Rabbit that unless he found him at once he would tell his father that the Rabbit had allowed him to wander away and get lost. At this the Rabbit became very frightened, and killed the second cub also.

"Then he wondered what to do, and after thinking of various plans he climbed a tall tree and threw himself into the top of a large thorn bush. He then limped off to find the Lion, and having found him he told him that he had been attacked and that the poor little cubs had been killed, while he himself had been severely injured, as he could see, in trying to defend them. The Lion said, 'Did you recognize those that attacked you?' and the Rabbit replied that he did. 'Then,' roared the Lion, 'go and find them that I may kill them.'

"The Rabbit fled, and when out of sight started to wander along, wondering what he was to do, for he knew that if he tried to escape the Lion would catch him and kill him.

"And as he wandered along he came to the village of the Baboons and found them playing at tops, the game in which each player in turn tries to knock down the dried core of a corn-cob standing on end without causing his top to stop spinning. Then the Rabbit sat down and joined in the game, and said to the Baboons, 'Among my people we play this game, but we make it much more interesting by each player shouting a question as he throws, which is answered by his fellows.'

"Now the Baboons love to copy anything that they see others do, and they pressed the Rabbit to teach them. So he said, 'Well, the question we like best is, "Who killed the Lion's cubs?" and the answer is, "I did, I did."'

"Having made sure that they would remember the answer the Rabbit hurried back to the Lion. When he found him, he said, 'I have found those who killed your children. Come, and you shall hear them confess that they did it, for they are proud of it.'

"So they went both together to the Baboons' village, and the Rabbit led the Lion stealthily into a thicket that grew near the open space in the middle of the village. The Baboons were still spinning tops, and the Rabbit, signing to the Lion to remain, went forward and joined in the game. Then, flicking a top with a skilful throw that knocked down the cob, he cried, 'Who killed the Lion's cubs?' and all the Baboons shouted in reply, 'I did, I did.' Then the Lion rushed out of the thicket and killed them two or three at a time.

"A bad Rabbit, a too cunning Rabbit, and one who caused the innocent to die to save himself, but, Bwana, you will see that he is the cleverest of all the animals."

COTTON STATISTICS
CONSUMPTION AND STOCKS

BY

JOHN A. TODD, M.A., B.L.

The state of affairs with regard to the world's consumption of cotton during the past season is probably unique. For the first time in history, at least since the Civil War, the world's consumption of American cotton has actually been exceeded by that of Outside Growths during the second half of the season (American, 5,940,000 bales; Outside Growths, 6,067,000). The causes which have led to this result are almost as interesting as the fact itself. Briefly the position is that, owing to the Wall Street crash in October, 1929, the consumption of cotton in the United States was severely reduced during the latter half of the season, and as the U.S. use practically nothing but their own cotton this would in any case have involved a heavy reduction in the total consumption of American. But to make matters worse the rest of the world in 1929–30 carried still further than in previous years the tendency to substitute Outside Growths for American, with the result that their consumption of American was also reduced, and the world's total consumption of American for the season is the smallest since 1923–24. But owing to the greatly increased use of Outside Growths in the rest of the world, the world's total consumption of these is the largest on record, with the result that the world's total of All Kinds of cotton is not much less than the previous season, and not far short of the record figure of 1926–27.

As usual this marked transfer of consumption from one growth to another has been largely the result of relative prices, but it has been aggravated this year by the fact of the deterioration of the quality of the American crop. For some years the writer has been stressing this tendency, which is due, on the whole, to the substitution of shorter stapled varieties in America, especially in Texas, in the attempt to evade the boll weevil by earlier maturity. But in 1929 matters came to a head as the result of the drought in the West, which seriously injured the staple of most of the Texas crop.

As this change in consumption is the outstanding feature of the

season, we give here a table summarizing the position by seasons since 1920, and comparing the consumption of American and Outside Growths in (1) the U.S.A., and (2) the rest of the world, respectively.

RUNNING BALES (000's).

	American.		*Outside Growths.*		*All Kinds.*	
	U.S.A.	*Rest of World.*	*U.S.A.*	*Rest of World.*	*U.S.A.*	*Rest of World.*
1920–21 ..	4,677	5,356	183	7,730	4,860	13,086
1921–22 ..	5,613	7,115	276	8,105	5,889	15,220
1922–23 ..	6,322	6,272	294	9,155	6,616	15,427
1923–24 ..	5,353	5,727	252	9,064	5,605	14,791
1924–25 ..	5,917	7,353	225	9,814	6,142	17,167
1925–26 ..	6,176	7,560	224	10,726	6,400	18,286
1926–27 ..	6,880	8,897	252	10,110	7,132	19,007
1927–28 ..	6,535	8,872	236	9,898	6,771	18,770
1928–29 ..	6,778	8,288	245	10,561	7,023	18,849
1929–30 ..	5,811	7,212	249	11,937	6,060	19,149

The facts are also shown in further detail in the diagram on page 44, which gives the figures half-yearly; and without describing that diagram in detail, it may be pointed out that the whole crux of the position is in the relative movements of the third and fourth lines in the diagram, which since July, 1925, have been moving almost exactly in opposite directions.

The important question is whether this tendency will continue in future years. As far as the United States are concerned their consumption will almost certainly revive; in fact, as will be seen from the details in Table II., it has already begun to do so during the first three months of the current season. Whether the rest of the world will come back to American is still very uncertain. There has already been a distinct reaction in relative prices, both American and Egyptian being now relatively cheaper than they were in the latter part of last season, which, by the way, was largely the result of Government action, but it is not possible yet to trace the effect statistically.

The effect of these unusual developments is seen in the world's carryovers of American and Egyptian cotton. The American carry-over (excluding linters) has gained 1,774,000 bales on the year, while the Egyptian carryover has reached a figure far beyond anything previously recorded. In each case the Government holds a substantial part of the carryover, about 1,300,000 bales of American

and 3,323,000 kantars of Egyptian. With regard to the Egyptian carryover we have found it necessary to change the basis of compilation. Prior to January, 1924, Sudan cotton in Liverpool was included in the stocks of Egyptian, and when it was first entered separately the figure was not important. Recently, however, the figure has been rising to a substantial amount, and as the seasonal movement of the Sudan stocks is quite different from that of Egyptian the result was to affect the end of season comparisons rather seriously. We have, therefore, taken Sudan cotton out of the table altogether.

In previous years we have given a diagram of the relative consumption of (*a*) American and (*b*) " All Kinds " of cotton in the various groups of cotton-using countries. It is impossible to repeat that diagram this year, but the figures are interesting (see Table I.). In American, the U.S.A. and the Continent have suffered most, while Asia has lost hardly anything, and the U.K. relatively not so much, because it was so bad before. In " All Kinds " the striking feature is the rise of Asia to a record total, almost as large as the Continent, in contrast with the heavy fall in the U.S.A. The U.K. has also fallen again, and is now not much above the post-war low record of 1920-21.

Two interesting points of detail may be noted in Tables II. and III. The consumption of Egyptian cotton in the United States has been falling steadily since April, and the latest figures, since the opening of the new season, are the lowest since 1921. This is presumably the effect of the new tax on imported staple cottons. The World's Monthly Carryover of American cotton, which was not a record at the end of last season, has since August been rising very rapidly, as the result of the early movement of the crop and the small consumption; and at the end of October the monthly total was a new record for that date.

TABLE I.—WORLD'S CONSUMPTION OF COTTON.
(FROM THE STATISTICS OF THE INTERNATIONAL FEDERATION.)
(*Running Bales, 000's Omitted—Excluding Linters.*)

Variety.	*Season.*	*U.K.*	*Continent.*	*U.S.A.*	*Asia.*	*All Others.*	*Totals.*
American ..	1911–13*	3,701	4,865	5,086	513	132	14,297
	1923–24	1,695	3,199	5,353	661	172	11,080
	1924–25	2,344	4,009	5,917	772	228	13,270
	1925–26	2,093	4,194	6,176	1,012	261	13,736
	1926–27	2,077	4,797	6,880	1,756	267	15,777
	1927–28	1,949	5,143	6,535	1,513	267	15,407
	1928–29	1,910	4,614	6,778	1,431	333	15,066
	1929–30	1,474	4,055	5,811	1,427	256	13,023
	1st Half	880	2,191	3,157	728	127	7,083
	2nd ,,	594	1,864	2,654	699	129	5,940
Indian ..	1911–13*	49	807	5	3,043	1	3,905
	1923–24	201	1,247	27	3,922	7	5,404
	1924–25	183	1,108	31	4,165	34	5,521
	1925–26	168	1,063	30	4,273	38	5,572
	1926–27	82	855	28	4,203	28	5,196
	1927–28	121	962	27	3,389	24	4,523
	1928–29	183	1,150	35	3,766	44	5,178
	1929–30	188	1,375	61	4,403	60	6,087
	1st Half	100	685	31	2,156	13	2,985
	2nd ,,	88	690	30	2,247	47	3,102
Egyptian ..	1911–13*	384	377	127	20	7	915
	1923–24	469	354	149	39	16	1,027
	1924–25	431	350	128	49	13	971
	1925–26	391	334	136	42	17	920
	1926–27	369	389	160	51	25	994
	1927–28	358	394	145	43	17	957
	1928–29	365	401	155	43	25	989
	1929–30	301	415	137	58	26	937
	1st Half	167	217	76	27	15	502
	2nd ,,	134	198	61	31	11	435
Sundries ..	1911–13*	140	1,946	26	774	939	3,825
	1923–24	353	529	76	1,351	576	2,885
	1924–25	277	896	66	1,523	785	3,547
	1925–26	370	1,619	58	1,308	1,103	4,458
	1926–27	482	1,511	64	1,362	753	4,172
	1927–28	476	1,557	64	1,646	911	4,654
	1928–29	342	1,947	55	1,480	815	4,639
	1929–30	502	2,044	51	1,825	740	5,162
	1st Half	268	1,012	25	890	437	2,632
	2nd ,,	234	1,032	26	935	303	2,530
All kinds ..	1911–13*	4,274	7,995	5,244	4,350	1,079	22,942
	1923–24	2,718	5,329	5,605	5,973	771	20,396
	1924–25	3,235	6,363	6,142	6,509	1,060	23,309
	1925–26	3,022	7,210	6,400	6,635	1,419	24,686
	1926–27	3,010	7,552	7,132	7,372	1,073	26,139
	1927–28	2,904	8,056	6,771	6,591	1,219	25,541
	1928–29	2,800	8,112	7,023	6,720	1,217	25,872
	1929–30	2,465	7,889	6,060	7,713	1,082	25,209
	1st Half	1,415	4,105	3,289	3,801	592	13,202
	2nd ,,	1,050	3,784	2,771	3,912	490	12,007

* Average of 1911–12 and 1912–13.

TABLE II.—U.S. CONSUMPTION OF COTTON BY VARIETIES.

(RUNNING BALES 000's: "FOREIGN" IN EQUIVALENT 500-LB. BALES.)

		Total.	*Upland.*	*Sea Island.*	*American Egyptian.*	*Egyptian.*	*Other Foreign.*	*Linters not Included.*
Season's Totals.	1912–13	5,483·4	5,195·6	54·8	—	201·3	31·7	303·0
	1913–14	5,577·4	5,301·4	81·7	—	151·1	43·2	307·3
	1914–15	5,597·4	5,295·9	79·4	—	181·2	40·8	411·8
	1915–16	6,397·6	5,998·0	82·6	—	269·3	47·7	880·9
	1916–17	6,788·6	6,376·0	94·3	—	259·2	59·1	869·7
	1917–18	6,566·5	6,296·8	85·9	—	136·4	47·4	1,118·8
	1918–19	5,766·0	5,517·6	51·2	21·1	126·1	50·0	457·9
	1919–20	6,419·8	5,914·2	43·0	45·9	323·1	93·6	342·5
	1920–21	4,892·7	4,641·5	18·7	16·8	159·2	56·6	516·3
	1921–22	5,909·9	5,554·7	9·0	49·4	226·3	70·5	639·0
	1922–23	6,666·1	6,250·8	6·3	65·2	262·3	81·5	646·1
	1923–24	5,680·6	5,312·0	4·9	36·0	223·6	104·0	536·7
	1924–25	6,193·4	5,894·5	4·0	19·0	191·5	84·4	658·8
	1925–26	6,455·9	6,161·7	2·3	11·7	204·1	76·0	803·8
	1926–27	7,189·6	6,859·2	1·2	19·7	239·8	69·7	806·1
	1927–28	6,834·1	6,518·6	1·3	15·1	217·6	81·5	780·2
	1928–29	7,091·1	6,763·9	0·8	13·5	232·4	80·5	879·3
	1929–30*	6,113·9	5,799·2	—	12·2	206·1	96·5	804·4
Monthly Figures, 1928–29.	August	526·3	500·8	—	0·8	18·8	6·0	70·1
	September	492·3	469·7	—	0·4	16·3	5·8	70·9
	October	616·2	588·6	—	0·9	20·1	6·7	78·8
	November	611·2	587·2	—	1·0	17·9	5·1	69·4
	December	533·3	509·7	—	1·0	18·0	4·6	58·7
	January	668·3	638·0	—	1·5	22·3	6·5	69·4
	February	594·7	567·8	—	1·0	19·5	6·4	68·2
	March	631·7	602·9	—	1·1	20·5	7·1	76·6
	April ..	631·8	603·0	—	1·3	20·2	7·3	79·5
	May ..	668·6	637·6	—	1·3	20·5	9·2	79·9
	June ..	569·4	542·5	—	1·4	18·0	7·5	77·9
	July ..	547·2	516·9	—	1·8	20·3	8·1	79·8
Monthly Figures, 1929–30.	August	558·8	529·0	—	1·4	20·3	8·0	83·6
	September	545·8	518·2	—	1·0	17·5	9·1	81·9
	October	640·8	609·0	—	1·5	20·2	10·0	82·7
	November	544·1	517·6	—	1·0	18·5	7·0	63·4
	December	453·9	428·6	—	1·0	18·0	6·2	52·5
	January	577·2	548·8	—	1·1	19·7	7·7	62·4
	February	495·2	469·3	—	0·9	17·0	7·8	60·9
	March	508·6	483·3	—	0·9	15·8	8·6	64·0
	April ..	532·4	503·9	—	1·0	18·1	9·4	67·0
	May ..	473·9	449·0	—	0·9	15·9	8·0	68·8
	June ..	405·2	384·0	—	0·8	13·3	7·1	58·5
	July ..	378·8	359·1	—	0·7	11·7	7·2	58·6
1930–31.*	August	352·3	338·6	—	0·6	7·7	5·5	57·0
	September	394·3	378·8	—	0·5	7·9	6·9	62·8
	October	444·5	426·4	—	0·6	9.9	7·7	66·2

* Subject to revision.

TABLE III.—WORLD'S MONTHLY CARRYOVER OF *AMERICAN* COTTON.

(In Thousands of Running Bales, including Linters in U.S.A., also Sea Island and American Egyptian, but not Foreign Cotton.)

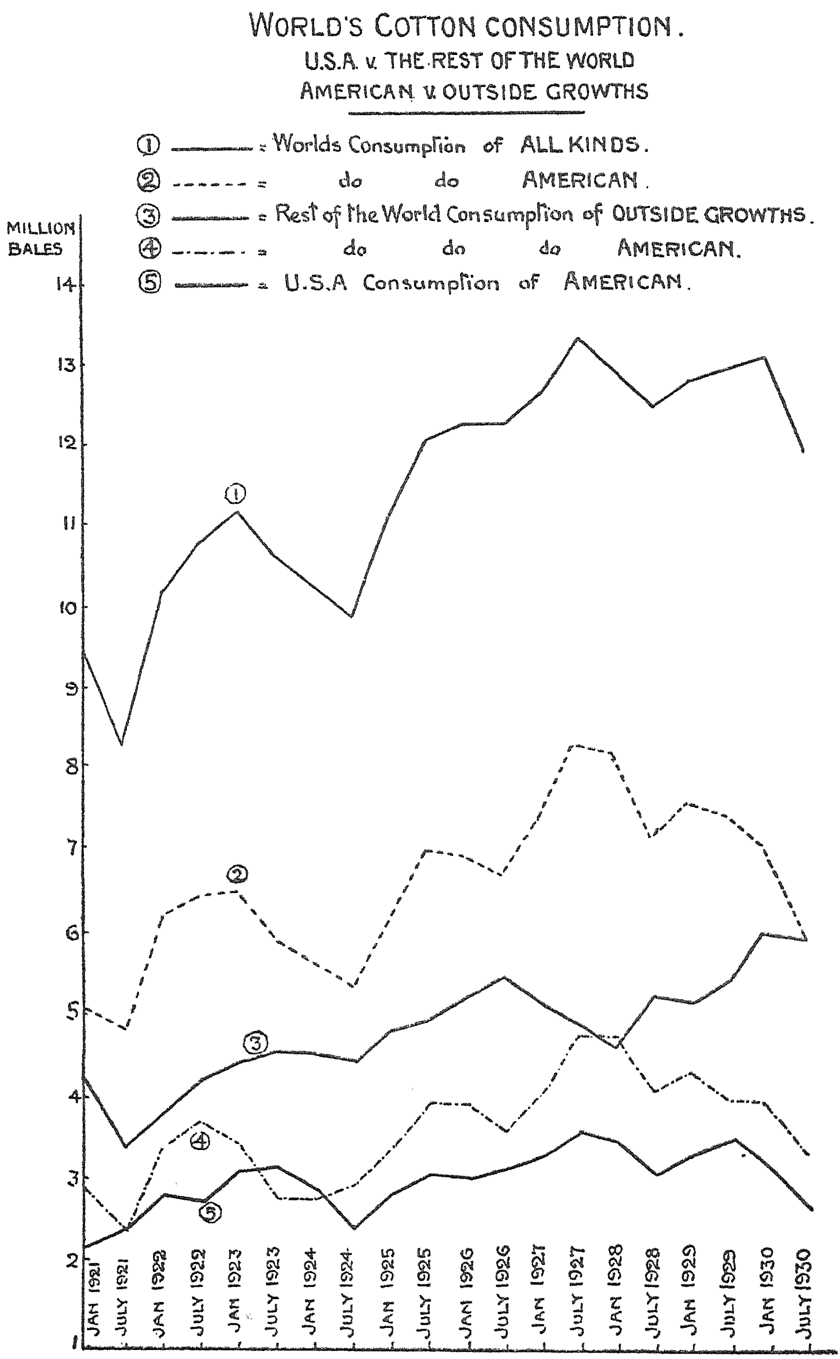
End of	Stock and Afloat.		U.S.A.		Monthly Totals.	Federation.	Half-Yearly Totals.	U.S.A.	End of Season Totals.
	U.K.	Continent.	Mill Stocks.	Public Warehouses.		Other Mill Stocks.		Elsewhere.	
1912, August ..	508	406	786	556	2,256	1,305	3,561	350	3,911
1913, August ..	423	282	699	492	1,896	1,011	2,907	375	3,282
1914, August ..	627	489	687	562	2,365	—	—	320	—
1915, July ..	1,238	753	1,491	1,839	5,321	—	—	850	—
1916, July ..	707	516	1,591	1,150	3,964	—	—	450	—
1917, July ..	237	332	1,521	1,069	3,159	—	—	440	—
1918, July ..	173	164	1,541	1,924	3,802	—	—	315	—
1919, July ..	806	486	1,519	2,402	5,213	—	—	1,150	—
1920, July ..	878	474	1,485	2,262	5,099	1,066	6,165	500	6,665
1921, July ..	839	805	1,222	3,874	6,740	1,137	7,877	1,960	9,837
1922, July ..	558	562	1,266	1,468	3,854	1,243	5,097	185	5,282
1923, July ..	187	206	1,109	903	2,405	713	3,118	310	3,428
1924, July ..	228	310	739	695	1,972	688	2,660	220	2,880
1925, July ..	401	373	916	516	2,206	1,046	3,252	270	3,522
1926, July ..	579	406	1,155	1,946	4,086	959	5,045	595	5,640
1927, July ..	1,011	1,079	1,524	1,856	5,470	1,731	7,201	590	7,791
1928, July ..	530	815	1,094	1,201	3,640	1,181	4,821	385	5,206
August ..	441	646	836	1,151	3,074	—	—	—	—
September	373	746	756	2,651	4,526	—	—	—	—
October ..	449	965	1,240	4,651	7,305	—	—	—	—
November	679	1,287	1,636	5,250	8,852	—	—	—	—
December	850	1,422	1,848	5,265	9,385	—	—	—	—
1929, January ..	938	1,338	1,901	4,657	8,834	1,260	10,094	—	—
February	930	1,243	1,889	3,906	7,968	—	—	—	—
March ..	864	1,115	1,880	3,216	7,075	—	—	—	—
April ..	830	1,001	1,745	2,553	6,129	—	—	—	—
May ..	694	810	1,593	1,864	4,961	—	—	—	—
June ..	543	679	1,373	1,386	3,981	—	—	—	—
July ..	442	563	1,119	981	3,105	1,197	4,302	360	4,662
August ..	367	418	834	1,370	2,989	—	—	—	—
September	339	584	808	3,207	4,938	—	—	—	—
October ..	454	1,000	1,401	5,323	8,178	—	—	—	—
November	528	1,145	1,742	5,869	9,284	—	—	—	—
December	583	1,275	1,928	5,949	9,735	—	—	—	—
1930, January ..	618	1,198	1,931	5,439	9,186	1,007	10,193	—	—
February	572	1,148	1,934	4,906	8,560	—	—	—	—
March ..	509	1,085	1,892	4,241	7,727	—	—	—	—
April ..	484	990	1,799	3,687	6,960	—	—	—	—
May ..	402	775	1,641	3,345	6,163	—	—	—	—
June ..	352	660	1,447	3,117	5,576	—	—	—	—
July ..	304	544	1,287	2,890	5,025	937	5,962	631	6,592
August ..	275	472	1,108	3,472	5,327	—	—	—	—
September	322	747	1,058	5,246	7,373	—	—	—	—
October ..	415	1,055	1,456	7,551	10,477	—	—	—	—
November	551	1,217							

TABLE IV.—WORLD'S MONTHLY CARRYOVER OF *EGYPTIAN* COTTON.

(KANTARS 000's BALES CONVERTED AT 7·5 KANTARS (EUROPE) AND 5·0 KANTARS (U.S.A.).)

End of	*Stock and Afloat.*		*U.S.A.*		*Alex-andria.*	*Monthly Total.*	*Federation.*	*Half-Yearly Totals.*
	U.K.	*Conti-nent.*	*Mills.*	*Ware-houses.*			*Half-Yearly.*	
1912, August ..	302	30	424*	—	350	1,106	1,387	2,493
1913, August ..	418	31	354	13	491	1,307	1,485	2,792
1914, August ..	467	10	259	26	766	1,528	—	—
1915, July ..	758	71	484	126	1,074	2,513	—	—
1916, July ..	351	50	617	296	104	1,418	—	—
1917, July ..	431	27	376	213	589	1,636	—	—
1918, July ..	541	185	180	157	1,727	2,790	—	—
1919, July ..	526	170	185	79	2,060	3,020	—	—
1920, July ..	466	79	587	514	601	2,247	1,365	3,612
1921, July ..	688	158	345	296	1,992	3,479	1,005	4,484
1922, July ..	835	148	314	267	1,669	3,233	1,252	4,485
1923, July ..	859	129	447	265	1,096	2,796	1,200	3,996
1924, July† ..	360	128	259	63	384	1,194	1,155	2,349
1925, July ..	323	75	253	57	411	1,119	1,103	2,222
1926, July ..	345	120	321	143	1,544	2,473	1,185	3,658
1927, July ..	533	143	295	66	2,392	3,429	1,283	4,712
1928, July ..	465	98	239	88	1,648	2,538	1,035	3,573
August ..	375	105	237	69	1,153	1,939	—	—
September ..	353	68	234	66	1,427	2,148	—	—
October ..	398	180	195	66	2,340	3,179	—	—
November ..	638	195	177	74	3,227	4,311	—	—
December ..	660	232	181	124	3,555	4,752	—	—
1929, January ..	585	225	224	131	3,458	4,623	1,140	5,763
February ..	630	150	228	130	3,326	4,464	—	—
March ..	585	150	244	132	3,116	4,227	—	—
April ..	578	173	314	189	2,931	4,185	—	—
May ..	630	158	409	226	2,618	4,041	—	—
June ..	540	158	446	215	2,135	3,494	—	—
July ..	510	150	449	197	1,677	2,983	1,260	4,243
August ..	450	165	458	174	1,164	2,411	—	—
September ..	368	120	454	162	1,332	2,436	—	—
October ..	465	180	397	142	2,536	3,720	—	—
November ..	555	240	361	128	3,164	4,448	—	—
December ..	638	233	361	162	3,223	4,617	—	—
1930, January ..	585	270	346	202	3,403	4,806	1,335	6,141
February ..	570	270	331	183	3,677	5,031	—	—
March ..	555	187	330	172	3,937	5,181	—	—
April ..	450	218	336	149	3,984	5,137	—	—
May ..	435	188	449	279	3,931	5,282	—	—
June ..	375	188	507	269	3,769	5,108	—	—
July ..	353	135	483	245	3,616	4,834	1,297	6,131
August ..	285	120	435	243	3,457	4,540	—	—
September ..	270	120	399	234	3,622	4,645	—	—
October ..	353	270	376	215	4,327	5,541	—	—
November ..	525	255			4,875			

* Total foreign—details not given.
† Excluding Sudan cotton in Liverpool since 1924.


WORLD'S COTTON CONSUMPTION.
U.S.A. v. THE REST OF THE WORLD
AMERICAN v. OUTSIDE GROWTHS
① = Worlds Consumption of ALL KINDS.
② = do do AMERICAN.
③ = Rest of the World Consumption of OUTSIDE GROWTHS.
④ = do do do AMERICAN.
⑤ = U.S.A Consumption of AMERICAN.
MILLION BALES
14
13
12
11
10
9
8
7
6
5
4
3
2
1
JAN 1921
JULY 1921
JAN 1922
JULY 1922
JAN 1923
JULY 1923
JAN 1924
JULY 1924
JAN 1925
JULY 1925
JAN 1926
JULY 1926
JAN 1927
JULY 1927
JAN 1928
JULY 1928
JAN 1929
JULY 1929
JAN 1930
JULY 1930

NOTES ON CURRENT LITERATURE

COTTON IN INDIA.

1. The following reports have recently been received:
BOMBAY: Ann. Rpt. of the Indian Merchants Chamber, 1929.
MADRAS: Year Book of the Agr. Dpt., 1929.
PUNJAB: Rpt. on Operations of Dpt. of Agr., 1929, Pt. II., Vol. I.

2. INDIAN CENTRAL COTTON COMMITTEE. THE PRESENT POSITION OF THE RESEARCH SCHEMES. (Bombay: G. Claridge and Co., Ltd.) A useful short account of the thirteen schemes for the betterment of Indian cotton financed by the Committee. Six more schemes will be commenced during the present year, and a brief review of their objects is also included.

3. BOMBAY COTTON MILLS: PROSPECTS. By F. Stones. (*Indian Text. J.*, **40**, 1930, p. 399. Abstr. from *Summ. of Curr. Lit.*, x., **18**, 1930, p. 495.) The new tariffs have given the Indian cotton mills ample protection and an opportunity to advance in the manufacture of medium counts longcloths, shirtings, and dhooties, and bleached and dyed goods, which formerly were imported from Lancashire and recently to a large extent from Japan. A proposed merger scheme for the Bombay mills is outlined.

4. MADRAS. *Cambodia Cotton Strains.* (*Digest No.* 88, Dpt. of Agr., Madras, 1930.) A strain evolved by the Department, known as Co. 2, is being multiplied for seed purposes in Coimbatore District by raising it on ryots' lands under seed-farm conditions. It was found that the quality of this strain last season was above the average.

5. COTTON IN THE PUNJAB. (*Rpt. on Operations of the Dpt. of Agr., Punjab,* 1929, Pt. II., Vol. I.) Experiments are being conducted on osmotic pressure, determination of temperature of cotton leaves, and transpiration. During the year under review the cotton crop was a failure, and insect pests in part contributed to this. Investigations have been carried out on the following: spotted bollworm, pink bollworm, aleurodidæ, leaf-roller, stem borer, cotton semilooper, green semilooper, red cotton bug. The following diseases were also responsible for injury to the cotton: anthracnose (apparently new to the Punjab), leaf-spot, and root rot.

6. "WHICH COTTON TO GROW?" By C. R. Singh. ("Seasonal Notes," *Agr. Dept., Punjab,* vii., **1**, 1930, p. 27.) Points out the advantages of the 289-F. variety.

7. INDIAN COTTON INDUSTRY: EFFECTS OF TARIFFS. By W. H. Slater. (*Indian Text. J.*, **40**, 1930, p. 353. Abstr. from *Summ. of Curr. Lit.*, x., **15**, 1930, p. 416.) An historical survey is made of Indian cotton duties, and their effects on the development of the Indian cotton industry and on India's import trade.

8. INDIAN COTTONS: PRODUCTION AND CONSUMPTION. (*Text. Weekly,* **5**, 1930, p. 424. Abstr. from *Summ. of Curr. Lit.*, x., **17**, 1930, p. 445.) A table is included showing the tendency of the consumption of the various growths of cotton by the British cotton industry in recent years. The figures show an increase in the use of Indian cottons from 1·24 per cent. in 1913 to 7·06 per cent. in 1929-30.

9. INDIAN COTTONS: USE IN LANCASHIRE. By H. Spibey. (*M/c. Guard. Coml.*, **21**, 1930, p. 95. Abstr. from *Summ. of Curr. Lit.*, x., **17**, 1930, p. 449.) The writer discusses the technical improvements suggested in the Cotton Inquiry Report, particularly the suggested greater use of Indian and other short-stapled

cottons. He also discusses the attempts which have already been made in this direction, and points out that in certain instances the saving effected in initial cost has been completely absorbed by enhanced waste and preparation cost, due to machine unsuitability and disproportionment. An investigation of mule spinning, with a view to making its service more economical, and bringing it upon a basis of productive equality, if not supremacy, to ring spinning, is recommended.

10. Foreign Markets for Indian Cotton Goods. By S. H. Mistry. (*Anglo-Gujarati Qrtrly. Jour. of the Indian Merchants' Chamber*, xxiii., **1**, 1930, p. 338.) The author commences with the remark that "there has been a regrettable tendency in our cotton manufacturing industry to underrate the importance of introducing Indian cotton piece goods in external markets. In concentrating its entire attention upon the local market in India, it has unduly ignored the claims of the export trade." The question is considered in some detail. It is stated that a certain amount of export trade goes on, the principal customers being Iraq, Persia, the Malay Peninsula, Ceylon, and East African countries. Since the war period Iraq has purchased about 35,000,000 yards, Persia 30,000,000 yards, the Straits Settlements 22,000,000 yards, Ceylon 18,000,000 yards, and East African territories 20,000,000 yards.

11. Japanese Cotton Trade with India: Statistics. (*Indian Text. J.*, **40**, 1930, p. 350. Abstr. from *Summ. of Curr. Lit.*, x., **15**, 1930, p. 417.) Tables are given showing Japan's total exports and imports, and total exports to India, and total imports from India from 1915 to 1928. In all the fourteen years for which figures are given, Japan has imported much more from India than she has exported. During the last three or four years imports from Japan into India, and exports from India to Japan, have decreased. Figures for wages in the Japanese textile industry show a downward trend, but wages are not lower in Japan than in India. Japan buys a large amount of cotton from India, while she exports to the latter country piece goods as well as yarn. An enormous reduction of imports of Japanese yarns into India in 1928 resulted from the enhanced duty on imported yarn. On the whole the imports of cotton piece goods have increased since 1925, but the Act of 1930 will probably cause a decrease similar to that of imported yarns. Imports of knitted goods from Japan into India have been increasing steadily. India must sell a large part of her cotton, and Japan is a very good customer. But imports of Indian cotton into Japan have been going down recently, and imports of American and Egyptian cottons have increased. In the production of finer counts Japan comes more into conflict with Lancashire and less into conflict with India. The present movement in Lancashire to go in for the production of lower counts to compete with Japan in coarser cloth will mean a conflict and competition with Indian cloth also.

[*Cf.* Abstracts **65**, **66**, **67**, **159** below.]

12. Technological Report on Banilla Cotton, 1924-30. By A. J. Turner. (*Tech. Bull.*, Ser. A, **16**, 1930. Indian Central Cotton Committee.) Banilla is the name which is now given to a cotton first styled BXX 27, and later called Dhulia 1 on account of its having been bred at Dhulia; it was first derived some nine years ago as a descendant from a cross made in 1908 between the two cottons Bani (*Gossypium indicum*) and Comilla (*G. cernuum*). Bani cotton has the desirable lint characters of length and silkiness, and Comilla cotton has the desirable agricultural characters of high ginning percentage and high yield. The Banilla cross has been isolated and developed with a view to substituting a high-yielding cotton of good quality lint for the very coarse types at present commonly grown in Khandesh.

The present report summarizes the various fibre and spinning test results which have been obtained for the cotton since the season 1924-25, and concludes with a general discussion of the results for the cottons grown in the different areas and seasons; a comparison is also made with the results obtained for some samples of the local Khandesh *roseum* cotton (N.R.) grown under similar conditions to the Banilla samples.

13. STANDARD INDIAN COTTONS: IMPROVEMENT. By H. Sri Rahula. (*Indian Text. J.*, **40**, 1930, p. 372. Abstr. from *Summ. of Curr. Lit.*, x., **15**, 1930, p. 388.) The results of tests of improved Indian cottons are discussed, and prices and acreages under cultivation are given. A new cotton, Cambodia Co. 2, has afforded an average fibre-length of 0·91 inch and a spinning range of highest counts 24/38. This is hardly as good as Cambodia Co. 1 (0·91 inch and 30/38), but its average yield is about 660 lb. per acre, and it is said to resist the stem weevil and black-arm better. Cambodia Co. 1 gave a yield of 500 lb. per acre at the breeding station, 250 lb. in irrigated tracts, and 50 to 100 lb. in unirrigated areas. Cambodia Co. 2, however, may not give the same yield on a large scale as at the experimental station. Surat 1027 A.L.F. (*G. herbaceum*) has given an average fibre-length of 0·96 inch, highest standard counts 26/34, and a yield of 586 lb. per acre on the Surat cotton farm. Dharwar 1 (*G. herbaceum*) has given an average length of 0·88 inch, range of highest standard counts 32/34, and a normal return of 300 lb. per acre. Gadag 1 (*G. hirsutum*) gave fibre-length 0·96 inch, highest counts 26/32, and an average yield of 215 lb. per acre on a 4,000-acre test farm. Nandyal 14 gave 0·90 inch, 30/34 counts, and 180 lb. per acre. This cotton has been found to be specially clean with low blowroom losses and a cardroom loss of about 8 per cent. Yarn breakages in the ring-frame only occurred in 34's counts. Punjab-American cottons 289F and 285F (*G. hirsutum*) have afforded, in six seasons, an average fibre-length of 0·98 inch, and 0·89 inch, and seasonal ranges of highest standard counts of 30/40 and 28/34 respectively. No. 285F has given an average return of 973 lb. of seed cotton per acre at the British Cotton Growing Association (Punjab), Ltd., farm at Khanewal, and 289F has given 1,173 lb. per acre. Blowroom and cardroom losses were high last season, and ring-frame breakages occurred in the 40's counts. No. 4F has given average fibre-length 0·75 inch, and range of highest counts 16/24. The importance of Umri Bani (*G. indicum*) is growing rapidly. Six seasonal tests have afforded an average fibre-length of 0·83 inch, and a range of highest standard counts 22/24. The price of this cotton is low compared with that of Punjab-American. The ginning percentage is 29.

14. LA CULTURE DU COTONNIER DANS L'INDE BRITANNIQUE. LA PRODUCTION DANS LES DIVERSES REGIONS. By Ray C. P. Boone. (*Coton et Cult. Coton.*, iv., **3**, 1929, and subsequent numbers.) An interesting account of the history of cotton in India, the varieties cultivated, climate, soils, cultivation methods, pests and diseases, etc.

COTTON IN THE EMPIRE (*EXCLUDING INDIA*).

15. The following reports have recently been received:
BRITISH GUIANA: Admin. Rpt. of Dir. of Agr., 1929.
CYPRUS: Ann. Rpt. of Dpt. of Agr., 1929.
FIJI: Ann. Rpt. of Dpt. of Agr., 1929.
NORTHERN RHODESIA: Ann. Rpt. of Dpt. of Agr., 1929.
NYASALAND: Ann. Rpt. of Dpt. of Agr., 1929.
QUEENSLAND: Ann. Rpt. of Expl. Work on Cotton at Callide, 1928-29.
SIERRA LEONE: Ann. Rpt. of Agr. Dpt., 1929.

SOUTH AFRICA: Year Book, 1928-29.
SOUTHERN RHODESIA: Meteorological Rpt., 1929.
SUDAN: Ann. Rpt. of Cent. Econ. Board, 1929-30.
Rpt. of Govt. Chemist, 1929.
TANGANYIKA: 2nd Ann. Rpt. E. Afr. Agr. Res. Station, Amani, 1929-30.
Rpt. of Dpt. of Tsetse Res., 1929-30.
Co-ordination Rpt., 1929-30.
UGANDA: Meteorological Observations, 1929.
WEST INDIES: *Grenada:* Rpt. of Agr. Dpt., 1929.
Leeward Islands: Rpt. on the Fed. Agr. Dpt. Govt. Lab., 1929-30.
St. Vincent: Rpt. on the Agr. Dpt., 1929.

16. CONFERENCE ON COTTON GROWING PROBLEMS, AUGUST, 1930. REPORT AND SUMMARY OF PROCEEDINGS. (Pubd. by the Empire Cotton Growing Corporation, 1930. Price 2s. 6d., post free.) A complete and detailed account of the whole meeting, not only with the papers, but with a verbatim report of what was said by those present.

[*Cf.* Editorial, p. 261, Vol. VII.]

17. EUROPE: MALTA. *Long-Stapled Cotton. Malta's Great Necessity.* (*Daily Chronicle*, Malta, August 26, 1930.) Malta was famous for its cotton in classical times, but the coming of the long-staple cottons, with mass production, has spoiled its market. The article is largely a translation of one by the Superintendent of Agriculture, describing experiments that have been carried out. The old original Maltese cotton is *G. herbaceum*, but of late a good deal of *G. hirsutum* has been grown. It has been found that Sakel does well, but requires irrigation. This need does not apply to American Long Staple Upland, which also gives promise of success.

18. ASIA: CEYLON. *Cotton Cultivation.* (*Ann. Rpt. of Dpt. of Agr.*, 1929.) From this report we quote the following: "Locally grown cotton was bought as usual by the officers of the Department on behalf of the Spinning and Weaving Company. The price paid was Rs. 14.50 per cwt. at Middeniya and Liyangantota and Rs. 15.50 at Bata-ata, Ambalantota, and Hambantota. No Government subsidy was paid. In the Southern Province the area under cotton was extended and the crop was almost double that of 1928. Yields were low; the weather was unsuitable, and the prevalence of fever among the growers led to inability to attend to weeds and cultivation and to the late maturing of the cotton. It is desirable that work should be continued with the local Cambodia strain. Indian varieties were imported during 1929, and are under trial at Tissamaharama; they will be judged on yield, for it is not expected that their lint will be of the same value as that of Cambodia.

"The Ceylon Motor Transit Company erected a saw gin at Ambalantota and ginned 1,000 lb. of seed cotton. A report on the lint shows that the work of the gin was satisfactory, and leads to a reconsideration of the question of a ginnery in the cotton area to which the seed cotton purchased from the growers can be taken, and from which selected seed can be obtained for the next season's sowing. At present the seed cotton is taken to Colombo by rail, and seed required for sowing has to be brought back to the cotton-growing districts."

19. CYPRUS. *Cotton Cultivation.* (*Ann. Rpt. of Dpt. of Agr.*, 1929.) Good rains in June, and favourable climatic conditions during the ripening period for both irrigated and early sown unirrigated cottons, accounted for the larger production obtained from only a slight increase in area planted.

The Department continues with variety trials in order to determine more definitely the best varieties suited to Cyprus conditions before the issue of large quantities of any imported seed.

Stronger measures are being taken to control the ravages of Pink Bollworm and Spiny Bollworm.

20. AFRICA. *Memorandum on Native Policy in East Africa.* (Cmd. 3573.) (Pubd. H.M. Stat. Off., 1930. Price 3d. net.) An important statement of the policy that will be followed in connection with the native inhabitants of East Africa. It deals with the general principle of trusteeship for the indigenous races, including encouraging them to make the most efficient use of their own resources for purposes of production, full regard being directed to the principle that the native should be in fact effectively free to work, as he may wish, either in his own tribal area, or on his own individual holding of land, or (subject to proper statutory safeguards of the conditions of employment) in labour for wages outside the tribal area. Among other things this involves keeping available for all the tribes land of such an extent and character as will fully suffice for their actual and future needs.

21. NYASALAND. *Cotton Cultivation.* (*Ann. Rpt. of Dpt. of Agr.*, 1929.) There was no substantial increase on the previous year's small acreage of cotton grown by Europeans, but there was a marked advance in the production of cotton by natives, the increase being almost 600 tons of seed cotton in excess of that of the previous record crop of 1925. As in recent years, the British Cotton Growing Association purchased the crop, the amount disbursed to the growers being £61,141.

Annexure C deals with the work of the Corporation at Makwapala and Port Herald Experimental Stations. Owing to soil problems at Makwapala the Over-the-Top variety of cotton has shown difficulty in coping with the conditions, but it is pleasing to note that the U.4 obtained from Barberton has shown signs of being suitable both for Makwapala and for Port Herald. At Port Herald the field experiment work has this season given excellent results. Several strains of cotton were under trial on a considerable scale, two of which—U.4 and Cambodia—completely eclipsed all other types. In connection with insect pests, jassid and stainers caused little damage, bollworm attack was normal, the greatest injury during the season being caused by aphis.

22. NORTHERN RHODESIA. *Cotton Cultivation.* (*Ann. Rpt. of Dpt. of Agr.*, 1929.) The experimental work has been continued with the object of finding a cotton suitable for Northern Rhodesia conditions. The results achieved are such as to cause an increasing feeling of optimism, and efforts will be made to still further improve the varieties considered suitable. The Agricultural Department expresses its great indebtedness to the Corporation, without the assistance of whose officers in South Africa and Southern Rhodesia the work could not have reached its present state of progress.

During the year the following major pests caused injury to cotton: jassid, Sudan bollworms, American bollworm, spiny bollworm, cotton stainers; cotton aphis is also liable to become a major pest. In addition the following minor pests were noted: plant suckers, leaf eaters, flower eaters.

23. *Memorandum upon Field and Experimental Work at the Central Research Station, Mazabuka.* By T. C. Moore. (*Dept. of Agr., Northern Rhodesia,* 1929.) Fields 10 and 34 contained small plots of various cottons, none of which showed much promise except U 4/4 and the Egyptian-Cambodia cross, which showed considerable resistance to jassid.

Records of cost of ploughing per acre were kept all over the station, and varied between 2s. 3d. and 7s. 7d. (new ground), with an exceptional figure of 9s. 5d. in a case delayed by rain. The average cost per acre of 661 acres was 3s. 7d.

24. SOUTHERN RHODESIA. *Some Further Notes on Cotton Growing.* By G. S. Cameron. (*Rhod. Agr. Jour.*, xxvii., **10**, p. 1026, and **11**, p. 1188, 1930.) In this

paper Mr. Cameron continues the useful hints on cotton growing in Southern Rhodesia for the benefit of those proposing to grow the crop for the first time. The hints refer to the following: Choice of Land, Fertilizers, Date of Sowing, Planting, Spacing, Cultivation, Stainer Traps, Picking, Sorting.

Speaking generally of the cotton crop, Mr. Cameron says it is too soon to estimate the final yield for this year, but although this may not come up to expectations, in the opinion of leading growers who have given U.4 a trial, the behaviour of the crop may be termed satisfactory. Several growers have decided to increase their acreages next season, while it is expected that others will take up cotton growing again on a more modified scale. This, in spite of low prices, appears to indicate a growing confidence in the crop.

25. SIERRA LEONE. *Quande Cotton.* (*Ann. Rpt. of Agr. Dpt.*, 1929, p. 24.) The work of selection with Quande cotton was continued during the year. Definite improvement has been obtained, and encouraging reports have been received from the British Cotton Growing Association. The lack of a hand gin has been a hindrance, and has resulted in the late sowing of the bulked strains, which have consequently not been grown under the best conditions.

26. SOUTH AFRICA. *Cotton Crop.* (*Crops and Markets*, viii., **11**, 1930, p. 242.) The production of cotton this season, both in the Union and Swaziland, is estimated at 12,114 statistical bales, as against 7,819 statistical bales for last season. The Senior Cotton Grader, Durban, reports that the quality of the crop is excellent, and in his opinion one of the best spinning crops—if not the best—that has yet been produced. The number of bales which have been off-colour also shows a considerable decrease in comparison with previous seasons; this is no doubt due to improved seed and favourable climatic conditions.

27. SUDAN. *Cotton Cultivation.* (*Ann. Rpt. Cent. Econ. Board*, 1929-30.) In the Gezira Irrigation Scheme the area under cotton was 131,351 feddans, an increase of 25,762 feddans over the previous season. The average yield was 3·55 kantars as compared with 3·29 kantars in 1927-28. At one period there was promise of a much higher yield, but the crop was adversely affected by pests and unfavourable weather conditions. In all the circumstances the yield can be considered as extremely satisfactory, considering the large area now under cotton. The quality of the lint was superior to that of the previous season. The Governor of the Blue Nile Province states that "the scheme appears to have lost none of its original and abundant attraction to the native, who, with traditional philosophy, is not unprepared for the occasional moderate year which is now coming after two exceptional and two good years."

The area under cotton in the present season is 174,150 feddans. The prospects are not so good, owing chiefly to phenomenal rains and to damage by insect pests.

At the Gezira Research Farm experiments with cotton have been carried out covering course rotations, water duty trials, cultural trials, manurial and variety trials. The area of the farm has recently been largely increased to cover future requirements.

Rain-grown cotton is beginning to play an important part in the development of the remoter districts, and as a remunerative money crop is compensating in some degree for the decline in trade in other commodities.

In Kordofan Province the native has taken kindly to cotton cultivation, and prospects of further expansion are good. In view, however, of the present low prices and possible difficulties in transport, which still relies mainly on the camel, a cautious policy is being adopted in regard to extension in 1930-31.

28. *Cotton Cultivation.* The latest report received is to the effect that the condition of both rain and flood grown cotton and of cotton grown on pumping stations is generally favourable.

29. Tanganyika Territory. *Cotton Experiments.* (*Bull. of Imp. Inst.*, xxvii., **3**, 1930, p. 360.) Describes distance of sowing, time of sowing, and varietal experiments at the Morogoro Experimental Station, and time of sowing and distance of sowing experiments at the Ibadakuli Agricultural Station, carried out during 1929.

30. *Report on the Development of the Rufiji and Kilombero Valleys.* By A. M. Telford (Crown Agents for the Colonies, London. Price 5s.) A detailed consideration of the agriculture of these valleys, with recommendations. Climate, soils, irrigation, past and present production, future agricultural development, transport, labour, marketing, pests and diseases, are all dealt with, and the report makes a very interesting study.

31. *East African Agricultural Research Station, Amani.* (*2nd Ann. Rpt.*, 1929-30.) Details of the work undertaken during the year are given in the form of progress reports from the Director, Plant Pathologist, Soil Chemist, Biochemist, Plant Physiologist, Plant Geneticist, Systematic Botanist, Superintendent of Plantations, Secretary and Librarian.

32. Uganda. *Cotton Prospects.* The latest report from the Department of Agriculture states that the condition of the cotton crop is generally satisfactory. Angular leaf spot has been observed in Teso, Mengo, and Entebbe Districts.

33. AUSTRALASIA: Queensland. *The Cotton Industry.* (*Queens. Agr. Jour.*, xxxiv., **1**, 1930, p. 38.) The Minister for Agriculture and Stock (Hon. H. F. Walker) recently announced that in view of the failure of Durango cotton to give satisfactory results under abnormal conditions in many areas, experiments would be put in hand to find another variety, or varieties, that would be suitable for Queensland conditions; he warned the growers, however, against the dangers of mixture of varieties in one district.

34. *Cotton Experimental Work, Callide Research Station*, 1928-29. Among the recommendations made are the following: Early planting to increase the possibilities of obtaining good yields; soaking the seed for three hours before planting to assist quicker germination; thinning late-sown plants at 6 to 8 inches high; application of fertilizers as top dressings when the plants are well established after the commencement of the early rains.

35. Fiji. *Cotton Cultivation.* (*Ann. Rpt. of Dpt. of Agr.*, 1929.) Adverse weather conditions and two severe storms caused serious damage to the cotton crops. A total of 344,399 lb. of seed cotton was purchased at the two ginneries at Lautoka and Sigatoka; the proportion of "A" grade cotton was satisfactorily high.

Seed selection and multiplication have been continued by Mr. Anson at the Cotton Experimental Station, and ratooning experiments with the object of comparing yields from ratoon and annual plants were undertaken. The work at the station was seriously hampered by the storms, but in spite of setbacks valuable results were obtained by the Cotton Specialist.

The supply of a suitable type of cotton which will replace Sea Island and yield good returns under the comparatively wet and humid conditions of Fiji appears to be in sight. It is now necessary to pay attention to crop rotations including cotton for the areas of the Colony suited to cotton production.

The chief pests and diseases encountered during the year were jassid, tipworm, pink bollworm, harlequin bug, stainers, and black-arm disease. The greatest injury was caused by jassid and tipworm.

36. West Indies. *Cotton Reports.* (*Trop. Agriculture*, vii., **10**, 1930, p. 282.)

Antigua.—The cotton area for 1930-31 is expected to be much larger than in recent years, probably some 700 to 800 acres.

Montserrat.—Rainfall has been short, but some of the cotton fields have come through well. Damage by pink bollworm appears to be decreasing.

St. Kitts-Nevis.—The present season's cotton crop is not expected to amount to more than 250,000 lb. lint, as compared with 327,300 lb. in 1929. Cotton pests have not caused any serious damage.

St. Vincent.—The change in the planting season from June to September has resulted in a greatly improved yield of clean, bright cotton, with a very small proportion of stains. Cotton pests have caused little damage. A much larger area is being planted to cotton this season, and more attention is being given to cultivation methods and to the application of manures.

37. *Sea Island Cotton.* (*Trop. Agriculture*, vii., **9**, 1930, p. 246.) With a view to assisting in the maintenance of the standard of Sea Island cotton in the British West Indies, and especially in St. Vincent, the Empire Cotton Growing Corporation have recently reopened the Cotton Breeding Station, which is in the charge of Mr. S. H. Evelyn. In addition, arrangements have been made whereby Dr. S. C. Harland, the Geneticist at the Cotton Research Station, Trinidad, will act as adviser on cotton-breeding matters to the College Advisory Department in the West Indies. It is believed that these new arrangements, made possible by the generous action of the Corporation, will have a very desirable effect in maintaining the purity of the existing strains of Sea Island cotton in the islands, and will further encourage growers to maintain their standards of quality.

38. St. Vincent. *Cotton Cultivation.* (*Rpt. on the Agr. Dpt.*, 1929.) The area under cotton for the 1929-30 season amounted to 2,867 acres, of which 1,758 were under Sea Island and 1,109 under Marie Galante cotton. This reduction in acreage over that of 1928-29 was due to the fact that many planters did not care for the change-over in the planting season from June to September. It is dangerous to form conclusions as the result of only one year's trial, but the majority of the planters are of opinion that the change-over is a move in the right direction. During the year soft rot disease was not prevalent, and there was little injury from insect pests. Work in connection with insect and fungus pests and their control was continued, the following being studied: cotton worms, pink bollworm, cotton stainers, bronze beetle, *Sclerotium rolfsii* (causing "damping-off" disease), black scale, and white scale.

An account is included of the working of the cotton ginnery. Seed cotton received for ginning amounted to 607,915 lb., a decrease of 132,574 lb. on the previous year's total.

39. *Cotton Prospects.* (*West India Comm. Circ.*, xlv., **832**, 1930, p. 350.) It is probable that the crop this season (1929-30) will exceed 700 bales, the largest ever grown in the island. Suggestions have been made that Marie Galante might with advantage be substituted for Sea Island in the island, but it is considered that the Sea Island cotton that has come forward this season is superior to last season's crop, and is more freely saleable than Marie Galante. Expert brokers have informed the St. Vincent Agricultural Credit and Loan Bank that they certainly would not substitute Marie Galante for Sea Island. There are very few buyers for the former, and it has to compete with Peruvian, Brazilian, and other similar growths which are produced in large quantities.

COTTON IN EGYPT.

40. Cotton in Egypt: *The Seventh Report of the Cotton Research Board,* 1928. It is stated in the preface that the inclusion of considerable detail in previous reports has often led to delay in publication. To obviate this, in future the reports

will consist largely of a series of records made during the particular year under review, and discussion of these will be kept down to a minimum.

In the Botanical Section, Ashmouni Malaki and Zagora Malaki have been dropped in favour of Giza 2, now called Ashmouni Geded. Giza 3 is proving better in the southern district. A large bee-proof breeding cage is in course of construction. This method of preventing natural crossing is cheaper than hand-bagging; the cotton plants are easily handled, and show no difference from those grown outside the cage. It is also intended to construct a mill for fine spinning, with thermostatic and hygrostatic control of the ventilation, and electrical machinery.

In the Agronomic Section details are given of the yields of the various cottons tested, and the results of manurial and rotation experiments.

In the Plant Protection Section the chief attention has been devoted to wilt disease and to control measures for pink bollworm, cotton worm, cotton aphis, and cutworms.

The report is profusely furnished with graphs.

41. Cotton Prospects. (*Int. Rev. Agr.*, xxi., **9**, 1930.) The crop has suffered from attacks of aphis and bollworm, the damage caused by the latter being 13 per cent. greater than last year.

42. Cotton Breeding and the Egyptian Variety Position. By C. H. Brown. (*Cotton*, M/c., October 18, 1930, p. 17.) The author states that the Egyptian Government, although carrying out both cotton breeding and the supply of stocks of pure seed, does not at present attempt to stop the production by any individuals or companies of new varieties, provided these attain a reasonable standard of purity. A complicated situation as regards varieties is bound to arise, and official action to prevent the growth of strains considered undesirable may have to be taken in the near future.

43. American and Egyptian Cotton: Supply and Price Relationship. By J. A. Todd. (*Man. Guard. Comm.*, 1930, **21**, 231. Abstr. from *Summ. of Curr. Lit.*, x., **19**, 1930, p. 530.) If, instead of considering only each season's crop, the total supply —that is, crop plus carry-over—is considered, a very close relationship between the supply and the season's price may be expected. A diagram based on statistics for both American and Egyptian cotton since 1920 brings out the general truth of the statement, with only two exceptions. The first was in 1921-22, when, owing to the deflation slump, prices of both American and Egyptian fell heavily, though the season's supply in each case was reduced. The second exception concerns American during the past two seasons, when the price has fallen though the supply has been reduced. The most popular theory to account for this fall is that it is due to deterioration in quality of the American crop. The diagram also throws an interesting light on the relative prices of American and Egyptian cotton. It has always been thought that the price of Egyptian was mainly controlled by the price of American, regardless of the amount of the Egyptian crop, but the diagram shows that the Egyptian price follows the Egyptian supply even more closely than in the case of American.

44. Egyptian Cotton Bales: Moisture. By A. S. Pearse. (*Int. Cot. Bull.* 8, 1930, p. 669. Abstr. from *Summ. of Curr. Lit.*, x., **19**, 1930, p. 513.) Italian and Swiss reports on the moisture contents of Egyptian cotton are given, together with a summary of the returns from Czecho-Slovakia, England, France, Germany, Italy, and Switzerland. The tabulation comprises 636 tests, representing in all 21,358 bales of both Upper and Delta cottons. The average of these tests showed a moisture regain of 9·475 per cent. for the 1929-30 crop on arrival at the spinning mills of Europe. It is estimated that the moisture paid for by the spinners during the year ending January 31 last equalled 5,715 bales, representing a loss

of £228,000 to the industry on the 9 per cent. basis. On the old standard of 8½ per cent. regain the loss would be equal to £387,640. The results are compared with previous tabulations, and an analysis per shipper is made.

COTTON IN THE UNITED STATES.

45. A FLIGHT FROM AMERICAN COTTON. By A. H. Garside. (*Amer. Cot. Ann. Rev.*, 1929-30, p. 19.) The record of the past year in the cotton trade has driven home more forcibly than ever the competition between American and other cottons, based on the possibility of substituting one growth of cotton for another to the extent of hundreds of thousands of bales, according to relative supplies and relative price levels. These are the facts stated in the briefest form, which constitute the explanation of one of the most drastic and most unexpected declines in world consumption of American cotton that the trade has ever seen. Fifteen million bales had been looked on as an average annual consumption, and last year showed only 13,250,000. The reasons for this great reaction are the world-wide recession of business activity and a substitution of foreign growths for American cotton on a scale never before witnessed. The paper analyses the question in some detail, and points out that the use of "foreign" cottons is outrunning the supply.

46. "AMERICAN COTTON: ANNUAL REVIEW" (1929-30 SEASON). (Pubd. by *Man. Guar. Coml.*, August 28, 1930.) The usual interesting review of all matters concerning the American cotton trade. The following articles, among others, are included: "Looking Back on 1929-30," W. G. Reed; "Outlook for 1930-31," C. T. Revere; "Less Weevil Damage this Season," Dr. G. D. Smith; "Work of the Cotton Textile Institute," G. A. Sloan; "Solving Mechanical Harvesting Problems," V. H. Schoffelmayer; "A Flight from American Cotton," A. H. Garside; "Obstacles in the Way of Acreage Reduction," G. W. Fooshe.

47. FACTS ABOUT COTTON: 1930 OUTLOOK. (*U.S. Dpt. Agr., Bur. Agr. Econ.*, 1930. Abstr. from *Exp. Sta. Rec.*, 62, 9, 1930, p. 887.) This series of mimeographed charts and tables presents data for various periods regarding the production, price, acreage, and yield of cotton, gross farm income from cotton and cotton seed, relation of cotton consumption and industrial production in the United States, foreign production of cotton, world carry-over, and the relation of gross income from cotton and expenditure for fertilizers in the cotton states of America. Other charts and tables show the relation between world supply and market value of cotton at New Orleans, the relation of price of cotton and industrial stocks and other commodities, changes in number of persons living on farms in the Southern States, 1924-1929, and changes in the acreage of cotton and other crops and in the number of livestock on farms in the southern states during 1926 and 1927.

48. ESTIMATING AMERICAN COTTON CROP. By J. A. Todd. (*Man. Guar. Coml.*, September 25, 1930, p. 327.) An account of the change in the methods of the U.S.A. Cotton Bureau in regard to prediction of crop, from reliance on the opinions of large numbers of outside reporters to a definite statistical handling of masses of data obtained by their own reporters.

49. COTTON: FORECASTING ACREAGE UNDER CULTIVATION IN U.S.A. (*Text. Rec.*, 48, 1930, 567. Abstr. from *Summ. of Curr. Lit.*, x., 15, 1930, p. 388.) The price of cotton when the farmer is marketing his crop is the dominant factor in determining the acreage planted in the following year. Other factors affecting the changes in cotton acreage are: (1) The price of cotton relative to other farm products when marketed; (2) the trend line of acreage over a number of years, whether rising or falling; (3) the percentage change in price any December to

the previous December; (4) the percentage change in acreage any year to the previous year; (5) the percentage change in acreage last year to two years preceding. Data for forecasting the cotton acreage are given, and the calculation for 1930 gives 42,992,000 acres for harvest during 1930. From this, 13,327,000 bales of 500 lb. each is submitted as a preliminary forecast of the size of the 1930 American cotton crop which will be harvested.

50. COTTON IN CALIFORNIA. (*S. Calif. Crops*, vi., **10**, 1930.) The latest report is to the effect that cool and cloudy weather has delayed harvesting in most cotton areas; the total crop is estimated as 224,000 bales. There is a shortage of labour in most districts.

51. SUMMARY OF RESULTS OF COTTON VARIETY EXPERIMENTS CONDUCTED DURING 1927-1929, AND PRODUCTION AND CONSUMPTION OF DIFFERENT STAPLE LENGTHS. By P. H. Kime and S. J. Kirby. (*N. Carolina Sta. Agr. Inform. Circ.* 42, 1930. Abstr. from *Exp. Sta. Rec.*, 62, 7, 1930, p. 629.) VARIETIES OF COTTON BEING RECOMMENDED BY COUNTY AGENTS AND VOCATIONAL TEACHERS OF NORTH CAROLINA. By P. H. Kime. (*N. Carolina Sta. Agr. Inform. Circ.* 43, 1930.) Both these papers recommend Mexican and certain Cleveland strains of cotton, which produce a staple of from $1\frac{1}{16}$ to 1 inches. The cotton of $\frac{7}{8}$ inch and less is exported, and has to compete with that of India and China.

52. COTTON VARIETY TESTS, 1929: SOUTH CAROLINA. By W. B. Rogers and E. E. Hall. (*S. Carolina Sta. Circ.* 40, 1930. Abstr. from *Exp. Sta. Rec.*, 62, **9**, 1930, p. 830.) The best strains of Cleveland led in production of seed cotton, and are recommended for general planting on wilt-free land.

53. COTTON RESEARCH IN SOUTH CAROLINA. (*S. Carolina Sta. Rpt.*, 1929. Abstr. from *Exp. Sta. Rec.*, 62, 7, 1930, p. 629.) Varietal trials showed that several of the strains of lint of 1-inch cotton produced by South Carolina breeders yielded as much lint as, and produced a greater acre money value than, the $\frac{3}{4}$ and $\frac{7}{8}$ inch cotton still planted by many growers. Strains of Cleveland, Cook, and Trice led at the Coast Substation. Cleveland strains and D. and P.L. No. 4 led the shorter cottons, and strains of Foster and Express were foremost among the long staples at the Pee Dee Substation.

Co-operative fertilizer trials in the State indicated that even with a systematic rotation liberal quantities of commercial fertilizer may be applied profitably to cotton; 200 lb. of sodium nitrate per acre appeared the most profitable application under test conditions. The highest yield was obtained when one-fourth of the nitrogen (50 lb. sodium nitrate per acre) was applied at planting, and the rest (150 lb.) at chopping. Lime, through its benefit to the legume crop in the rotation, indirectly yet decidedly enhanced yields of cotton and corn. Fertility studies indicated that a good cover crop of vetch and rye properly handled may be as valuable for producing cotton as an application of 8 tons of fresh manure per acre.

Acid-delinted seed treated with mercury dusts produced much better stands and higher yields of seed cotton.

Physiological studies revealed that cotton bolls early in the season ordinarily attain full size in from 18 to 20 days, although the weight rises steadily, so that the final dry weight at 45 days is nearly twice that of 18 to 20 days. The dry weight of the boll walls reaches a maximum between 18 to 25 days, while the later increase in dry weight is confined to the seed and lint. In spite of the decreasing succulence of the boll nitrogen is added continuously. No greater proportion of nitrogen is present during the very rapid growth in size in the early stages of boll development than in later stages when no size increase occurs. Determinations of nitrogen in leaves and other tissues indicated that nitrogen can be transferred from other parts of the plants to the bolls.

54. Cotton Variety Tests, 1929: Georgia. By G. A. Hale and H. K. Brabham. (*Ga. Sta. Circ.* 87, 1930. Abstr. from *Exp. Sta. Rec.*, 63, **1**, 1930, p. 34.) The Cleveland type cottons and similar varieties, such as Stoneville No. 2, D. and P.L. No. 8, College No. 1, and Burdette Acala, among the leaders in the trials, are considered well adapted for general planting in Georgia, except on wilt-infected lands of South-west Georgia, where the Toole, Lewis No. 63, Cook, Lightning Express, and Super Seven varieties may be planted.

55. Cotton Varieties, 1929: Mississippi. By J. F. O'Kelly and W. W. Hull. (*Miss. Sta. Circ.* 88, 1929. Abstr. from *Exp. Sta. Rec.*, 63, **1**, 1930, p. 34.) Cotton varieties leading in average acre yields of lint during the period 1925-29 included D. and P.L. 4-8, Cleveland 54, Piedmont Cleveland, Half-and-Half, and Cook 1010, and according to acre value D. and P.L. 4-8, Delfos 911, Deltatype Webber, Cleveland 54, and Express. D. and P.L. 6, Miller 5111, Lone Star 284, and Cleveland 54 led in value the varieties compared in 1929. Four strains of Miller, Cleveland 54, and Lightning Express led similarly in trials for wilt resistance.

(In these tests also the Cleveland varieties were among the best.—Ed.)

56. Cotton in the Panhandle of Oklahoma. By H. H. Finnell. (*Oklahoma Panhandle Sta. Bull.* 14, 1930, p. 8. Abstr. from *Exp. Sta. Rec.*, 62, **9**, 1930, p. 829.) Cotton experiments at Goodwell, at an elevation of 3,300 feet, with rainfall 17·8 inches annually, a frost-free period approximating 180 days, and a growing season for cotton of about 150 days, indicated that production possibilities on silty clay loam soil are too low to warrant consideration of cotton in competition with wheat and grain sorghums. Acala, Trice, and Oklahoma 44, followed closely by Lightning Express and Half-and-Half, seemed to be the better adapted varieties. Close spacing in the row was strongly indicated.

57. Weather and Cotton Yield in Texas, 1899-1929, Inclusive. By L. H. Daingerfield. (*U.S. Mo. Weather Rev.* 57, 1929, No. 11, p. 451. Abstr. from *Exp. Sta. Rec.*, 62, **9**, 1930, p. 809.) Data for temperature, precipitation, killing frosts, and boll weevil damage in Texas are summarized.

58. Intermediate Grades: American-Egyptian Cotton. (*Text. Rec.*, xlviii., **569**, 1930, p. 77.) An order signed by the Acting Secretary for Agriculture provides that American-Egyptian cotton, which in grade and/or colour is between any two adjoining grades of the official standards for this variety, shall be designated by the word "grade," and the grade number of the higher of two such grades, followed by the fraction "½." The new amendment became effective on July 3 last.

[And *cf.* Abstr. **43** above.]

59. Co-operative Fertilizer Experiments with Cotton. By M. Nelson. (*Bull.* 255, Agr. Exp. Sta., Arkansas, 1930.) A detailed account of experiments carried out during the years 1925 to 1929 inclusive, which showed that complete fertilizers consistently gave more profitable results on all areas than did fertilizing constituents used separately.

60. Field Crop Experiments at the South Mississippi Substation. By W. R. Perkins *et al.* (*Miss. Sta. Bull.* 274, 1929. Abstr. from *Exp. Sta. Rec.*, 63, **1**, 1930, p. 28.) Cotton fertilizer experiments were concerned with carriers of nitrogen, phosphorus, and potassium, rates of application, home *v.* factory mixed, and comparisons of formulas.

61. Fertilizer Rotation Experiments at the Pee Dee Station. By T. S. Buie *et al.* (*Bull.* 262, S. Carolina Agr. Exp. Sta., 1929.) Comparison is made of various fertilizer treatments in two cropping systems—three-year rotation and continuous cotton—and the conclusions presented include the following: Increasing the percentage of phosphoric acid to as much as 12 per cent. in a

1,000-lb. application of complete fertilizer has given marked increases in the yield of cotton in the rotation series. Applications of phosphorus have materially increased the earliness of the cotton crop, as indicated by the percentage of total yield secured at the first picking. Additional increments of nitrogen as high as 5 per cent. of ammonia gave increases in the yield of cotton grown in a rotation, and as high as 10 per cent. ammonia was efficient where cotton was grown continuously. Large amounts of nitrogen had the effect of delaying the maturity of the cotton crop when grown in a rotation. Increasing the percentage of potash in a 1,000-lb. application to 5 per cent. for cotton in a rotation and to 4 per cent. for cotton grown continuously was profitable. Potash has the apparent effect of slightly delaying the maturity of the cotton crop, but this is explained as being due to the greater late season yield where potash was used. The fallacy of attempting to produce cotton continuously without fertilizer regardless of the cropping system was clearly shown by the end of the second rotation, for at this time the yield of cotton showed marked decline.

62. TEXTILE RESEARCH IN U.S.A.: FINANCING. (*Text. World*, **77**, 1930, pp. 3373 and 3513. Abstr. from *Summ. of Curr. Lit.*, x., **16**, 1930, p. 444.) The Meritt Bill, under which the Textile Foundation, a Federal corporation, will be created to administer funds for research in textiles, has passed both Houses of Congress and is awaiting the President's signature. The fund will be administered by a board of directors, consisting of the Secretary of Commerce, Secretary for Agriculture, and three persons familiar with the textile industry and its allied branches, to be appointed by the President. Textile Alliance Inc. has been authorized by U.S. District Court decree to turn over $1,202,457 for transfer to the Textile Foundation when it is organized, $248,507 to the Philadelphia Textile School, $124,253 to an endowment fund for research in pure science at Princeton University, and $28,057 to the Massachusetts Institute of Technology.

COTTON IN FOREIGN COUNTRIES.

63. ASSOCIATION COTONNIÈRE COLONIALE. We have received a copy of *Bulletin No.* 92, 1930, containing accounts of cotton cultivation in the French Colonies. An article—"Etude sur l'égrenage du coton dans les régions eloignées des usines fixes," by C. Derulle—is also included, suggesting the use of transportable ginneries, with baling apparatus that will compress the cotton to the necessary density to allow of full load on the motor carrier.

64. BRAZIL COTTON INDUSTRY. (*Text. Rec.*, xlviii., **571**, 1930, p. 40.) Gives statistics of acreage, production, manufactures, etc.

65. ECONOMIC CONDITIONS IN JAPAN, JUNE 30, 1930. By G. B. Sansom and H. A. Macrae. We have received from the Dept. of Overseas Trade a copy of the above report. During 1929, 2,782,585 bales of yarn were produced by member companies of the Japan Cotton Spinners' Association. About 30 per cent. were coarse counts, about 32 per cent. 20's, and about 35 per cent. medium, only about 3 per cent. being classed as fine. The raw cotton consumed was 3,118,000 bales. Detailed figures of imports and exports are given, with a general account of conditions.

66. JAPANESE COTTON INDUSTRY: LABOUR CONDITIONS. By J. Kerfoot. (*Text. Weekly*, **5**, 1930, p. 383. Abstr. from *Summ. of Curr. Lit.*, x., **16**, 1930, p. 443.) Recent news from Japan regarding the labour position in the cotton mills shows that a crisis is imminent. Wages are being reduced, in one instance by 30 per cent. A society organized under the name of the Cotton Research Society is studying the possibility of joint purchase of factory requirements, joint contracts for electric power, insurance facilities, etc. Japanese spinners desire to extend

in China, rather than in Japan, but they hesitate about putting down more capital in China until labour conditions are more stable.

[*Cf.* Abstr. **486**, p. 321, Vol. VII., and **11, 159** in this number.]

67. Japanese Weaving Sheds: Efficiencies. By S. Seki. (*Indian Text. J.*, **40**, 1930, p. 401. Abstr. from *Summ. of Curr. Lit.*, x., **18**, 1930, p. 480.) The author illustrates with an example a method of calculating shed efficiency and production, and gives tables that indicate that these quantities are increased by (1) efforts of the management (particularly in small mills); (2) installation of humidification plant; (3) the use of weft pirns longer than 9 inches; and (4) the use of automatic looms. A table is also appended that gives particulars of cloth woven, types and numbers of looms, efficiencies and productions for some thirty Japanese mills.

68. Mexico: *Cotton Production.* (*Int. Rev. Agr.*, xxi., **9**, 1930.) Cotton production for the 1930-31 season is estimated at 185,800 bales, as against 246,000 bales in 1929-30.

69. Russian Textiles: Quality. (*Spinn. u. Web.*, **48**, 1930, No. 22, p. 20. Abstr. from *Summ. of Curr. Lit.*, x., **15**, 1930, p. 417.) Extracts from the Russian press indicate that complaints are being made of the poor quality of the post-war cotton fabrics. Some of the causes of this decline in quality lie in the use of old and worn machinery, lack of good measuring instruments, and of technical personnel and skilled workers, as well as of trained salesmen and managers. The political organization demands a reduction in costs of production, and this has been obtained in practice by a reduction in quality. Attempts are being made to improve the quality of the goods, and responsible people are imprisoned for producing goods of very poor quality or failing to maintain official standards.

70. Cotton: Cultivation in Central Asia. (*Leipz. Wochenschr. Text. Ind.*, **45**, 1930, pp. 530, 554. Abstr. from *Summ. of Curr. Lit.*, x., **15**, 1930, p. 388.) An extract is given from a Russian paper in which the present state of cotton cultivation in Central Asia, and proposals for its development, are discussed.

71. Syria: *Rpt. on the Econ. Conditions in Syria, dated July,* 1930. By R. Eldon Ellison. We have received a copy of this report from the Dept. of Overseas Trade. In reference to cotton it is stated that by far the greater part of the crop grown in Syria is produced in the Aleppo district. Next in importance is the Alaouites Territory, and a small quantity is also grown in the Damascus area. In Syria, the area under cotton cultivation in 1929 was more than four times greater than in 1928, equalling 17,000 hectares, all of which, with the exception of 1,100 hectares, were planted with the local variety known as "Baladi," the rest being under American ("Lone Star") or Egyptian varieties. The crop was 24,660 metric quintals (100 kilos), as compared with 5,700 metric quintals in 1928.

SOILS AND MANURES.

72. Soil Erosion. (*Science*, lxxii., **1866**, 1930, p. xii.) Mr. H. H. Bennett, of the Bureau of Soils, U.S. Dept. of Agriculture, read a paper at the First Inter-American Conference on Agriculture, Forestry, and Animal Industry in Washington. He said that "not less than 126,000,000 lb. of plant food are being washed out of the fields of America every year. Something like 17,500,000 acres of land that were formerly cultivated in this country have been destroyed by gullying or so severely washed that farmers cannot afford to attempt their cultivation or reclamation. This is enough land to support a nation. It exceeds the total area of arable land in Japan. An even vaster area of land has been injured by sheet erosion. This is a slower process of erosion, as distinguished

from gullying, which removes the film of soil from entire fields whenever it rains enough for water to run downhill. Erosion operates chiefly on top soil, the most productive part of the land."

Mr. Bennett described some of the areas in various parts of the country where as much as 40 inches of soil have been lost through erosion since the land has been under cultivation. In some places the land has been washed away to the underlying rocks. Cropping schemes, construction of terraces, soil-saving dams, and vegetative obstructions are some of the means of reducing the evils of soil erosion.

In regions where some of the land-saving measures are already being tried, it have been found that both the quantity and quality of the crop have improved. In the cotton crop, for instance, it was found that uneroded land—that is, land which had not lost its top soil—produced more lint cotton per acre, more seed, and the seed itself yielded more oil. Since cotton seed may be bought on the basis of oil content in the near future, this last is considered an important discovery.

73. Factors influencing Run-off and Soil Erosion. By A. B. Conner *et al.* (*Bull.* 411, Div. of Agr., Texas Agr. Exp. Sta., 1930.) A study of factors influencing run-off and soil erosion and the effects of conservation on the increase in crop yields, carried out at Substation No. 7, Dickens County, Texas.

74. An Account of the Nutrient Substances taken from the Soil by the Cotton Plant. By S. A. Kudrin. (Trans. title.) (*Trudy Uzbek. Selsk. Khoz. Opytn. Sta.*, No. 4, 1928, p. 12. Abstr. from *Exp. Sta. Rec.* 63, 1, 1930, p. 21.) On the basis of analyses made on several varieties of cotton (*Gossypium hirsutum*), primarily on variety No. 182, the author states that this variety, when grown under irrigation in Turkestan, may show the largest increase in the organic total at the stage of ripening, and a later decrease due primarily to the falling off of the dying plant parts. A decrease with age was noted in the proportion of nitrogen and in that of ash. The bolls and the seeds showed the largest amount of nitrogen and of phosphorus, and the leaves and the stalks the largest amounts of calcium and of magnesium. Decrease occurred with advance in age in the relative amounts of all nutritive substances in the stalks and fibre, as well as in the relative amounts of nitrogen and phosphorus in the leaves and of calcium and magnesium in the seeds. At the same time an increase was noted in the relative amounts of nitrogen and of phosphoric acid in the seeds, also of calcium and magnesium in the leaves. With age, translocation occurs of nitrogen and ash constituents from the vegetative into the reproductive parts. While the nitrogen and the phosphoric acid of the reproductive organs comprised, in the last growth stages, two-thirds of the total in the plant, calcium remained chiefly in the vegetative parts, and magnesium distributed itself uniformly throughout the plant. As regards the accumulation of the principal nutrients during the stage of blooming and boll formation, that of nitrogen is more rapid than is that of phosphorus and of magnesium. A fairly large supply of nutrients per unit area of soil is required for cotton. However, these nutrients are, during growth, concentrated in that portion of the plant which may be left to the soil (the cottonseed cake). Because of the small amounts of the nutrients in the fibre, cotton culture may be continued without serious lowering of nitrogen or of ash constituents, provided the other constituents of the plant are returned to the soil.

[*Cf.* Abstr. **259**, p. 162, Vol. VII., of this Review.]

75. Tropical Soil Surveying. By F. Hardy. (*Trop. Agriculture*, vii., 1930, pp. 235 and 274.) The chief kinds of tropical soil surveys, which are considered in these articles, may be classified as follows: Reconnaissance soil survey; Plant-geographical (broad ecological) soil survey; Specific physiological-ecological soil survey; Special-purposes soil survey. The first two are particularly applicable

to agricultural exploration of undeveloped tropical countries; the third to established agricultural areas, such as experiment stations, estates and farms. The fourth kind of survey is adapted to the needs of hygiene, sanitation, public health officers, etc.

76. Water Loss at Wad Medani (Sudan). Pt. I. By R. H. K. Peto and H. Greene. (*Jour. of Agr. Sci.*, xix., Pt. iv., 1929.) An account of experiments directed towards establishing relations between meteorological data and irrigation practice.

77. The Relationship of Climatic and Geological Factors to the Composition of Soil Clay and the Distribution of Soil Types. By E. M. Crowther. (*Proc. of Roy. Soc.*, B, Vol. 107, 1930.) An attempt is made to separate the effects on soil formation of two quantitative climatic factors and a qualitative geological grouping by means of a statistical analysis capable of application to other geographical and ecological problems. The data discussed consist of chemical analyses of the clay fractions of thirty representative soils and maps of the distribution of the more important soil groups in the United States.

78. Eine Vereinfachte Methode zur Untersuchung der Bodenstruktur an Grossen und Sehr Grossen Bodenproven ohne Abhangigkeit von Laboratorium. By —. Nitzsch. (*Fortschritte der Landwirtschaft*, Berlin-Wien, 1930. Abstr. from *Int. Rev. Agr.*, Mnthly Bull., Agr. and Sci., xxi., **5**, 1930, p. 162.) The writer has developed a simplified method for studying the volumetric constitution and structure of arable or untilled soils in the field without laboratory processes or equipment. The method, which uses comparatively large (1,000 c.c.) or even very large (30 litres) quantities of soil, is described, and a figure given of the apparatus used in each case. The results obtained with 1,000 c.c. samples are compared with those of the Burger-Nitzsch method previously used, and the differences are slight. There is, moreover, a satisfactory agreement between parallel determinations made with the new method.

[*Cf.* Abstr. **53, 59, 60, 61** above.]

CULTIVATION, IRRIGATION, GINNING, USE OF SEED.

79. Application of Science to Agriculture. By Prof. A. E. V. Richardson. (*Queensland Agr. Jour.*, xxxiv., **1**, 1930, p. 18.) An interesting paper in which the author discusses the importance of science to agriculture; the bearing of science on human progress and industrial development; the far-reaching effects of the scientific discoveries of the chemist, the biologist, and geneticist; the question of refrigeration; the development of labour-saving machinery; limitations of agricultural research; application of science to the major industries. The work of the Council for Scientific and Industrial Research and of the State Departments of Agriculture is also discussed.

80. Cotton Plants, Tame and Wild. By T. H. Kearney. (*J. of Hered.*, xxi., **5**, 1930, p. 195.) A very interesting and well-illustrated article, dealing with the subject under the following headings: Cotton Domesticated in Prehistoric Times; The Beginnings of European Contact with Cotton; What Cotton Plants are like; Development and Structure of the Seed Hairs; Biological Significance of the Seed Hairs; Geographical Distribution of Gossypium; Classification of the Cultivated Forms; Wild Species of Gossypium; Origin of the Modern Commercial Cottons.

81. Cotton: Community Cultivation. By O. F. Cook. (*U.S.D.A. Reprint from Year Book of Agr.*, 1927, No. 1025, 1929. Abstr. from *Summ. of Curr.*

Lit., x., **16**, 1930, p. 418.) The advantages of community production, by which only one variety of cotton is cultivated in a neighbourhood, are outlined. The seed is kept free from admixture at the public gins, and cotton of higher and more uniform quality is therefore obtained.

[And *cf.* Abstr. **54, 55, 56** above, and **90** below.]

82. Cotton Spacing. II. Effect of Blooming on Earliness, Fruit Set, and Yield. By J. O. Ware. (*Bull. No.* 253, Agr. Exp. Sta., Arkansas, 1930.) An increase in stand up to an average of 51,000 plants to the acre enhances the rate of blooming in the first three weeks of the blooming period. This results in the setting of sufficient fruit for a crop earlier in the season than where a thin stand exists. The earlier setting of fruit is indicated by a larger first picking where stands are thick than where stands are thin. The speeding up of seasonal blooming is not always reflected in increased production. Thick spacing increases the first picking of some varieties more than in other varieties. Thick spacing does not overcome the lack of productivity in a mediocre yielding variety. Close spacing produces a better crop with early attacks of boll weevil. If conditions surrounding the crop are favourable for growth and fruit production throughout the growing season, the cotton plant adjusts itself to a wide range in stand and yields practically the same returns regardless of spacings within limits of 10,000 to 50,000 plants per acre. On the other hand, if the soil is poor or does not contain sufficient fertility to produce large plants, closer spacing is necessary. The rows should be of such width and the stand in the row should be of such adjustment that sufficient vegetative framework can be produced on the land to bear an ample crop of bolls. A thick stand, however, is advisable any year on any land. A good recommendation to follow is two to three plants a hoe width apart on all lands, the rows 3½ to 4 feet wide on rich land, 3 to 3½ feet apart on land of medium fertility, and less than 3 feet wide on poor land. A thick stand on rich land does not materially reduce yields under any circumstances. In addition, it is a good boll weevil and leaf-worm measure, and a safer insurance against late season weather unfavourableness. A thick stand is indispensable to best production on poor land.

83. The Influence of "Motes" on the Yield and Boll Size of the Cotton Plant. By H. E. Rea. (*J. Amer. Soc. Agron.*, 21, **12**, 1929, p. 1154. Abstr. from *Exp. Sta. Rec.*, 62, **6**, 1930, p. 520.) Coefficients of correlation determined in sixteen varieties of cotton grown at the Temple Substation, Texas, in 1925 and 1926 gave indications that, although the relationship was not very close, the association between the percentage of motes and the yield of seed cotton per plant was usually negative. The percentage of motes per plant was closely and negatively associated with the average size of boll per plant—*i.e.*, the higher the percentage of motes the smaller was the boll.

[*Cf.* Abstr. **390**, p. 249, Vol. VII.]

84. Cotton Harvesting Machines. By V. H. Schoffelmayer. (*Man. Guar. Coml. Amer. Cot. Rev.*, 1930. Abstr. from *Summ. of Curr. Lit.*, x., **19**, 1930, p. 499.) Recent progress in the development of mechanical harvesters is outlined. The Smith-Conrad Combine Cotton Harvester (*cf.* Abstr. **218**, Vol. VII.) harvests the seed cotton and separates it from the burr in the field in one continuous process. The machine is adaptable anywhere on smooth land where cotton will not grow higher than 40 inches. It can be operated as a stationary unit in the field with hand-snapped cotton carried to it by human pickers. It costs about $20.84 a bale to hand-snap cotton, and $10.42 a bale to gin it. The combined harvester will harvest a bale for $1.94, and the cost of ginning is $6. Costs for hand-picking cotton range from $15 to $20 a bale, and the usual charge for ginning is $7 to $8. The International Harvester Company of America has

developed a cotton stripper in which rubber blocks are used instead of fingers to remove the bolls. The latest development of the picker as distinguished from the stripper type of harvester is a small and light hand-pulled machine developed by the American Cotton Picker Corporation. The principle of the machine is one of wiping the seed cotton from the open boll, the nozzles of the picker being directed by human hands. The great claim made for the machine is that it raises the grade of the cotton by approximately $10 a bale by removing all dirt and trash with a built-in air cleaner. The picker heads incorporate two inwardly revolving spools fitted with wipers mounted in an aluminium cage, and each picker head attaches to the hand of the worker like a glove. Among other mechanical pickers brought out in recent years is the International Harvester Company's machine based on the Price-Campbell principles, but this machine is still in the experimental stage; it is operated by a tractor and uses spindles to gather.

[*Cf.* Abstr. **146**, below.]

85. A New Disc-Type Gin. (*Text. Rec.*, xlviii., **571**, 1930, p. 82.) In a gin which separates the cotton from the seed by pressure against the sides of revolving discs the pressure comes from a cone-shaped rubber roller. It is the revolution of the latter which, as the patentee puts it, " pulls the fibre off the seed in the same manner you would do it with your fingers." Each disc, from its 6-inch to its outside 12-inch diameter, is roughened or fluted after the fashion of a knife-sharpening steel, which enables the cone rubber to hold the fibre against the disc with the necessary firmness, yet with little pressure. In operation the rubber cone has $\frac{1}{2}$ inch grip on staple 1 inch in length. The inventor is Mr. Cary S. Cox, of California.

86. Extension Work. By S. M. Gilbert. (*Trop. Agriculture*, vii., **10**, 1930, p. 260.) A very interesting article on demonstration and propaganda work among tropical peasantry, which deals in greater detail with the subjects brought up in this journal (Vol. VII., p. 85, 1930). The main points stressed by the author are (*a*) that successful demonstration and propaganda work depend, in the end, on the ability of the available staff quickly to gain friendly relations with the peasants as a whole; and (*b*) that the methods adopted for the work should be simple, cheap, give an adequate return over old methods or save labour, and not conflict with local laws, customs, or religion.

DISEASES, PESTS, AND INJURIES, AND THEIR TREATMENT.

87. Report of the Third Imperial Entomological Conference, June, 1930. (Imp. Inst. of Ent., 41, Queen's Gate, S.W. 7. Price 2s. net.) A general account of the meetings, with appendices on (I.) The Work of the Imperial Bureau of Entomology, 1925-30; (II.) Estimates of Expenditure; (III.) Discussion on the Organization of Entomological Departments; Entomological Work among Backward Races; Tsetse Control; The Control of Insects by Cultural Methods; Locusts; Biological Control of Insects; The Control of Weeds by Insects; The Control of Orchard Pests.

88. Some Tendencies in Modern Economic Entomological Research. By T. J. Headlee. (*J. Econ. Ent.*, xxiii., **1**, 1930. Abstr. from *Rev. App. Ent.*, xviii., Ser. A, **8**, 1930, p. 386.) The necessity for increased study of the bionomics of insect pests and their reaction to their physical and biological environment is pointed out, and recent developments in chemical, biological, and physical methods of control are discussed. The manner in which economic entomologists may be aided in their task by the systematic entomologist, the insect physiologist, the biochemist, the biophysicist, and the economist is indicated.

89. THE ENTOMOLOGIST IN RELATION TO COTTON INSECT PROBLEMS OF TODAY. By B. R. Coad. (*Jour. of Econ. Ent.*, xxiii., 4, 1930, p. 667.) An interesting paper. The author states that publicity given cotton insects in recent years has created an impression of great increase in damage, but statistics indicate that while there has been some little tendency of the sort, this impression has been largely created because the farmers have become more observant of their insect problems. Some form of reasonably profitable control measure is available for all major pests, but recent developments producing overlapping infestations of several pests in the same field have brought about such a complicated situation that timely localized advice is frequently needed. The U.S. Bureau of Entomology has been testing an experimental co-operation with the research and extension workers in the States of South Carolina and Oklahoma, where weekly field surveys of insect activity are made and used as a basis for prompt advice to the farmers. The experience gained warrants the belief that some similar system could be used to advantage in many other sections of the cotton belt.

90. RATOON COTTON IN RELATION TO INSECT PESTS. By I. Bishara. (*Tech. and Sci. Serv. Plant Protection Section, Bull. No.* 96, Min. of Agr., Egypt, 1930. Price P.T. 5.) From the summary we extract the following: "In concluding these investigations (in Egypt), one has only to confess the grave danger from the system of ratooning in the presence of such dangerous pests as the pink bollworm and the Egyptian spiny bollworm. The authors cited are fully justified in condemning the practice from the entomological point of view. Why is it, then, that some farmers approve the system, and seek to alter the existing legislation which allows no ratooning in any part of the country ? This point is dealt with in the following section.

"*Where Ratoon can be Allowed.*—In the northern provinces bordering the Mediterranean there are large tracts of waste land not yet reclaimed. Among these, however, some areas are being cultivated, but the yield of the various crops is rather low, especially with plants like cotton which have deep roots. Thus in districts like Fua, annual cotton gives only about one kantar per feddan compared with three or four for the rest of the Delta. The chief factors for the low yield are a high water table and a high proportion of soluble salts. (Where proper watering and drainage occur, as, for example, on His Majesty's estate at Edfina, just opposite Fua, annual cotton gives as high a yield as four kantars on the reclaimed plots. Many more examples can be given in the northern Delta region.) The consequence is a poor crop, which is made still poorer by increased bollworm attack from ratoon cotton near by, which gives a fair crop. Under such conditions the contrast between annual and ratoon becomes so marked that the cultivators in these areas are naturally impressed by the situation, and urgently demand permission to ratoon.

"The writer is fully convinced that the real need of these areas is not ratoon cotton, but proper irrigation and drainage. The fulfilment of these requirements is, of course, mainly outside the scope of the farmers themselves, but fortunately the Government has laid down, and is already carrying out, immense schemes for the improvement of these poor soils as well as for the reclamation of vast areas not yet cultivated. In the meantime, farmers of Fua and similar districts may be allowed to ratoon, as under existing conditions it is the most profitable method of cultivation."

91. ENTOMOLOGY. By M. A. Hussain. (*Rpt. Dpt. Agr.*, Punjab, 1928-29, Pt. I., Lahore, 1930. Abstr. from *Rev. App. Ent.*, xviii., Ser. A, 9, 1930, p. 462.) *Cotton Pests* : It is stated that differences in temperature are responsible to a large extent for the abundance of the pink bollworm (*Platyedra gossypiella*, Saund.) in the south-eastern and eastern parts of the Province, and for its com-

parative scarcity in the canal areas and further west. Investigations have shown that the resting larvæ in stored cotton seed are destroyed by exposure to the sun, and as the main emergence of the adults occurs in June, July, and August, exposing the cotton seed to the sun during April and May would provide a cheap and simple method of reducing the numbers of the moth in the field. Studies on the influence of temperature and humidity on *Dysdercus cingulatus*, F. (red cotton bug) showed that the optimum temperatures for its development were between 70° and 95° F., with a humidity between 40 and 100 per cent.; the climatic conditions believed to have been responsible for partial failures of the cotton crops adversely affect the multiplication of the bug.

92. Actes du Conseil International Scientifique Agricole. Première Session, Novembre, 1927. (*Int. Inst. Internat. Agr. Rome*, 1928. Reports received 1930. Abstr. from *Rev. App. Ent.*, xviii., Ser. A, **9**, 1930, p. 495.) The reports on cotton pests in vol. i. include records of *Earias insulana*, Boisd., and *E. vernana*, Hb., from the Mediterranean coast of Spain, where they cause severe damage to the flowers and developing bolls. In Italian Somaliland *Platyedra gossypiella*, Saund., *Heliothis* (*Chloridea*) *obsoleta*, F., and *Diparopsis castanea*, Hamps. (red bollworm), are important pests, as are the jassid, *Empoasca* (*Chlorita*) *facialis*, Jac., and *Syagrus rugiceps*, Lef., the larvæ of which feed on the roots and the adults on the leaves. Less serious injury is caused by *Earias biplaga*, Wlk., *Dysdercus cardinalis*, Gerst., and *Oxycarenus hyalinipennis*, Costa. The report in vol. ii. by H. Morstatt contains a review of the biology, distribution, and control of *Anthonomus grandis*, Boh. (Mexican boll weevil), and *Platyedra* (*Pectinophora*) *gossypiella*, Saund. (pink bollworm). The discussions on locusts are dealt with very briefly in the first volume; in the second a report is given by C. Isaakides on the organization of locust control in Greece, where the species occurring are *Calliptamus* (*Caloptenus*) *italicus*, L., and *Dociostaurus maroccanus*, Thnbg.

[*Cf.* Abstr. **5**, **40** above.]

93. Calcium Arsenate Tests, 1929: A Progress Report on Small-Scale Tests, comparing Boll Weevil Control with Lucas' Green Cross Calcium Arsenate *v.* a "Standard Brand" of Calcium Arsenate. By W. E. Hinds. (*Jour. of Econ. Ent.*, xxiii., **4**, 1930, p. 672.) In tests carried out in the field in various ways the Lucas materials proved generally more efficient.

94. Pink Bollworm in Arizona (Abstract). By S. A. Rohwer. (*J. Wash. Acad. Sci.*, xx., **10**, p. 189. Baltimore, Md., 1930. Abstr. from *Rev. App. Ent.*, xviii., Ser. A, **9**, 1930, p. 457.) Infestation by the pink bollworm (*Platyedra gossypiella*, Saund.) has been discovered at twenty-five different points in the Salt River valley, and in some fields in the eastern part of the valley 45 per cent. of the cotton bolls were attacked. The non-cotton zone is surrounded by a protective one, three miles in width, where restrictions are placed on the date when cotton may be planted. It is hoped that an appropriation of £117,500 for cleaning up of these zones will make possible the eradication of the moth from this area.

95. Pink Bollworm in Texas. (*Texas Sta. Rpt.*, 1928. Abstr. from *Exp. Sta. Rec.*, 62, **7**, 1930, p. 652.) In work conducted to determine the best methods to use in field clean-up operations against the pink bollworm, it was found that a very high mortality resulted from winter irrigation following winter burial of infested material, and that winter irrigation or winter burial alone was not effective.

96. Results of Airplane Dusting in the Control of Cotton Bollworm (*Heliothis obsoleta*, Fab.). By F. Sherman. (*J. Econ. Ent.*, xxiii., **5**, 1930, p. 810.)

General observations indicated that more bollworm damage appeared on the heavily dusted cotton than on the untreated areas.

97. A Note on Alabama Argillacea. By S. C. Harland. (*Trop. Agriculture,* vii., **10**, 1930, p. 281.) In this note Dr. Harland discusses the paper by G. N. Wolcott, entitled "The Mystery of Alabama Argillacea," and continues with an interesting account of the migratory habits of this pest, which has its centre, it is suggested, in North Brazil, and from there migrates far north and south as the temperature changes.

[*Cf.* Abstr. **91**, Vol. VII.]

98. Oviposition of the Corn Earworm Moth in Relation to Nectar Flow of Some Flowering Plants. By J. W. Nuttycombe. (*Jour. of Econ. Ent.*, xxiii., **4**, 1930, p. 725.) Studies at Charlotteville, Va., indicate that food is a strong factor in determining the number of eggs deposited by corn earworm moths (*Heliothis obsoleta,* Fab.). These moths feed upon the nectar from the blossoms of a great variety of plants, the overlapping flowering periods of which cover the oviposition period of the moths. Nectar flow from these plants, although greatly curtailed by drought, is apparently never so reduced as greatly to affect oviposition; consequently search must be made elsewhere for factors causing marked disturbances in the normal seasonal abundance of the eggs.

99. The Brown Cutworm (*Euxoa radians,* Guen.). By G. A. Currie. (*Queensland Agr. Jour.*, xxxiv., **1** and **2**, 1930, pp. 10 and 138.) A very useful and detailed account dealing with the life history of the brown cutworm: laboratory technique; temperature reactions; results of temperature work; description of life-cycle stages. The paper is well furnished with illustrations and graphs.

100. The Onion Thrips on Seedling Cotton, with a Season's Record of Parthenogenetic Development. By C. O. Eddy and W. H. Clarke. (*Jour. of Econ. Ent.*, xxiii., **4**, 1930 p. 667.) Infestations of the onion thrips (*Thrips tabaci,* Lind.) caused seedling cotton plants to grow slowly and assume a malformed condition. Buds were rarely blasted. Lateral growth sometimes resulted. Unfolding leaves had holes, marginal erosions, raised thin areas, and a crinkly surface. Using approximate figures, the average unmated female lived fourteen days and laid fourteen eggs in a period of eight days. Individuals developed in fourteen days, nearly five days being spent in the egg, between two and three in each of the two larval instars, one and one-half in the propupa, and three in the pupa. In July a generation followed the previous one as closely as fifteen days, the period lengthening to twenty-six days in August.

101. Tsetse Fly in South Africa. By M. C. Mossop. (*Bull. No.* 44, Dept. of Agr., S. Africa, 1928.) Deals principally with the common tsetse of Zululand, *Glossina pallidipes,* and the cattle diseases which are caused by tsetse fly.

102. Tanganyika: *Tsetse Fly Control. Ann. Rpt. on Exper. Reclamation,* 1930.) Mr. C. F. M. Swynnerton, Director of Tsetse Research, summarizes the work at Shinyanga as follows: "The decision to take a fly-belt and, in co-operation with the Administration, try what we could do against it with the knowledge at our disposal—this to be reinforced by suggestions gained from research—has been justified by the practical results. Annual clearings are now being made by the tribe itself as a *custom*; passages are being broken through into great natural open spaces; the organized grass-fires have brought further result without appreciable destruction of wooding or game; natives and cattle are entering in numbers to seize on our gains; a township has been built on the ground and trees are being planted by thousands where five years ago our one need was to get

rid of them. Much practical knowledge has been acquired and the fly-belt, in course of being broken into blocks for piecemeal treatment, stands ready for further experiment.

"Research has hardly yet come into the picture, but as the direct result of the interest aroused by Shinyanga, a research team has come into being, and its earliest discoveries—that of the 'feeding-grounds' (Jackson), and that of the fly's dependence on eyesight for hunting (Nash)—are being used."

Further highly important experimental work is being carried out.

103. THE INFLUENCE OF ENVIRONMENTAL CONDITIONS ON THE DEVELOPMENT OF THE ANGULAR LEAF-SPOT DISEASE OF COTTON. II. THE INFLUENCE OF SOIL TEMPERATURE ON PRIMARY AND SECONDARY INFECTION OF SEEDLINGS. By R. H. Stoughton. (*Ann. Appl. Biol.*, xvii., 1930, p. 493.) The following summary is given: (1) Seed derived from diseased plants may give rise to infected seedlings; (2) this infection is due to bacteria carried on the outside of the seed and in the fuzz; (3) thorough disinfection of the outside of the seed results in healthy seedlings; (4) the amount of primary infection resulting from infected seed decreases at soil temperatures above 30° C., but infection is not inhibited at 40° C.; (5) soil temperature has little or no effect on secondary infection resulting from spray inoculation of the plants; (6) plants diseased in the seedling stage grow out free from disease if no further inoculation occurs.

[*Cf.* Abstr. **89**, Vol. VI., p. 86, of this Review.]

104. LEAF-CURL IN COTTON. By T. W. Kirkpatrick. (*Nature*, cxxv., **3157**, 1930, p. 672. Abstr. from *Rev. App. Mycol.*, ix., **9**, 1930, p. 590.) Referring to a statement in an article entitled "Cotton in Africa" (*Nature*, February 22, 1930, p. 291) to the effect that leaf-curl has been observed on cotton in the Sudan, and that a jassid is implicated in the spread of infection, the writer states that in the Gezira (the chief long-staple cotton-producing area of the Sudan) this disease (which should preferably be termed "leaf crinkle") is transmitted mainly, if not exclusively, by an undetermined species of white fly (*Aleurodidæ*).

105. COTTON ROOT-ROT DISEASE. By W. N. Ezekiel. (*Biol. Abs.*, **4**, 1930, p. 1342; from *Phytopath.*, **19**, 1929. Abstr. from *Summ. of Curr. Lit.*, x., **19**, 1930, p. 498.) A report of a cotton root-rot conference in Texas. Recent work on *Phymatotrichum omnivorum* in relation to soil reaction, control on the "black lands," varietal resistance, mycological relations, and soil fertility studies are briefly discussed.

106. PHYTOPATHOLOGICAL INVESTIGATIONS AT THE TEXAS STATION. (*Texas Sta. Rpt.*, 1928. Abstr. from *Exp. Sta. Rec.*, 62, **7**, 1930, p. 643.) Cotton root-rot studies showed that infected live roots play an important part in the spread of the disease. Where the soil was sifted to remove such roots the disease did not appear the subsequent year. No variety or strain of cotton was found to be immune.

107. PLANT PATHOLOGY AT THE ARKANSAS STATION. (*Arkansas Sta. Bull.*, 246, 1929. Abstr. from *Exp. Sta. Rec.*, 62, **9**, 1930, p. 844.) It was determined by V. H. Young *et al.* in studies of the cotton wilt organism grown on various liquid nutrient media, and also on a single medium, but with varying amounts of nitrate, that there was at first an increase in the dry weight of mycelium followed by a decrease. Accompanying the decrease there was an increase in the production of ammonia in the culture fluid. There was noted a definite trend towards alkalinity, finally reaching pH 9, at which point the phosphate was precipitated.

Tests of twenty-five cotton varieties for wilt resistance under field conditions showed a wide variation ranging from 44 per cent. in the susceptible Trice 304 to a bare trace in the resistant varieties. Several varieties were found to combine resistance with other desirable qualities.

Temperature relations of the wilt organism were studied by Young, who tentatively reports that little wilt develops until real warm weather prevails. No marked differences were found by A. L. Smith between various biological strains of the cotton wilt fungus with respect to colour on standard media, type of spore production, vigour of growth, pathogenicity, and in their effect on the H-ion concentration of the culture medium.

108. PLANT PATHOLOGY AT THE SOUTH MISSISSIPPI SUBSTATION. By W. R. Perkins *et al.* (*Miss. Sta. Bull.*, 274, 1929. Abstr. from *Exp. Sta. Rec.*, 63, 1, 1930, p. 44.) The results of various quantitative and qualitative tests of potash fertilizers as controls for cotton wilt, as indicated in the resulting yields of seed cotton, are presented, and show rather inconsistent returns. Of various organic mercury and other disinfectants used in the treatment of cotton seed, none was notably beneficial as regards germination, control of wilt, or yields.

109. VIRUS DISEASES IN PLANTS. I. TRANSLOCATION WITHIN THE PLANT. II. THE AMŒBOID INTRACELLULAR INCLUSIONS. By J. H. Smith. (*Biol. Reviews*, v., 2, 1930, p. 159. Abstr. from *Rev. App. Mycol.*, ix., 8, 1930, p. 539.) The writer summarizes and briefly discusses some of the more important contemporary literature on two aspects of the virus diseases of plants—namely, the translocation of the infective principle within the host, and the amœboid intracellular inclusions. With regard to the former, it is concluded that transport is probably effected mainly by the phloem, the rate of spread being apparently too high for movement from cell to cell, and too low for conveyance by the water stream. Respecting the intracellular inclusions, the author inclines to the view (supported by his recent investigations) that these bodies are not living organisms, but reaction products of the host cells to the virus irritant.

[*Cf.* Abstr. 375, p. 244, Vol. VII. of this Review.]

110. DIE KULTUR DES SCHIMMELPILZES ASPERGILLUS NIGER ZUR BIOCHEMISCHEN BESTIMMUNG DER KALI- UND PHOSPHORSÄUREDÜNGEBEDÜRFTIGKEIT DER BÖDEN. By H. Niklas. (*Die Ernahrung der Pflanz.*, Berlin, 1930. Abstr. from *Int. Rev. Agr. Monthly Bull. Agr. and Sci.*, xxi., 6, 1930, p. 210.) An interesting study of the culture of *Aspergillus niger* as a means of testing soil requirements in potash and phosphates. In spite of imperfections and even sources of error in the method it seems a promising idea, for it is simple, inexpensive, and makes it possible to carry out a number of tests rapidly. It requires an acid medium, so is complementary to the Azotobacter method, which requires an alkaline medium.

111. THE "FORK" DEFORMATION IN COTTON PLANTS, ITS CAUSE, NATURE, AND EFFECT ON THE PLANT. By V. V. Yakhontov. (In Russian.) (*Tashkent. Glavn. Khlopkov. Komitet*, 1929. Abstr. from *Rev. App. Ent.*, xviii., Ser. A, 7, 1930, p. 329.) A peculiar deformation of cotton, recorded from various parts of Turkestan, and observed by the author in the Bokhara region, is described. The seedlings show an excessive development of the cotyledons, the surface of each of which is often 16·7 sq. cm. (2·6 square inches), and the axillary bud falls off. Observations indicated that it results from infestation of the bud by *Aphis gossypii*, Glov., *A. laburni*, Kalt., *Macrosiphum* (*Acyrthosiphon*) *gossypii*, Mordv., or *Thrips tabaci*, Lind., or from its destruction by biting insects such as *Longitarsus pellucidus*, Foudr. The injury is fatal only when the plant is also infested at the top of the roots by soil pests, those observed including various Coleoptera, *Feltia exclamationis*, *L.*, and *Euxoa segetum*, Schiff. In 1928 there were numerous cases in which the deformation was solely due to infestation by *Hypera* (*Phytonomus*) *variabilis*, Hbst. (lucerne weevil), which injured the buds and tops of the roots of the cotton seedlings. If the top of the roots is free from infestation, the injury caused to the axillary bud usually results in the formation of a new one in three to eight days, and should this new bud be destroyed as well, a third one

is produced in three to thirteen days, and the plant recovers. Sometimes two new buds are formed, giving rise to two independent stems. Injury to the top of the roots only does not produce any deformation. The physiological processes occurring in the injured plants are discussed in detail.

112. DETECTION OF FUNGUS MYCELIUM IN MILDEWED COTTON FABRICS. By M. W. Jennison. (*Science*, lxxii., October, 1930, p. 347.) Pianese III*b* stain is useful for differentiation. The material is washed in alcohol, stained for 15 to 45 minutes, washed in water, decolorized in acid-alcohol, dried, and mounted in Canada balsam or gum damar. The cotton fibres stain green and the mycelium a deep pink. It is desirable to tease out heavy fibre before mounting.

113. MILDEW ANTISEPTICS: INHIBITORY ACTION ON GROWTH OF MOULD FUNGI. By R. G. Fargher *et al.* (*Bull. Soc. Bot.* [France], 1929, **76**, p. 516. Abstr. from *Summ. of Curr. Lit.*, x., **15**, 1930, p. 405.) The properties required of an antiseptic suitable for general use in the cotton industry are outlined, and the results of investigations of the action of various substances on the growth of mould fungi on nutrient media in the laboratory are discussed.

114. FUNGOUS DISEASES OF PLANTS IN AGRICULTURE, HORTICULTURE, AND FORESTRY. By Dr. J. Eriksson. (Baillière, Tindall and Cox, London, 1930. Price 35s. Postage: inland 9d.; abroad 1s. 6d.) This is the second edition of this useful work. Methods of prevention and control of the various diseases are given.

115. FUSARIUM HYPHÆ: COMPOSITION. By R. C. Thomas. (*Biol. Abs.*, **4**, 1930, p. 1031; from *Amer. J. Bot.*, **15**, 1928. Abstr. from *J. of Text. Inst.*, xxi., **9**, 1930, A 529.) Analyses of cell walls of twelve species of *Fusarium* showed the same general structural plan.

116. THE PHYSIOLOGY AND BIOCHEMISTRY OF BACTERIA—II. and III. By R. E. Buchanan and E. I. Fulmer. (Baillière, Tindall and Cox, London, 1930. Price 34s. each, or 90s. for the three volumes.) The final volumes of an orientation to and summation of modern bacteriology. Vol. I. (1928) deals with growth phases and related subjects; Vol. II. with effects of environment on micro-organisms; Vol. III. with effects of micro-organisms on environment.

117. MANUAL OF DETERMINATIVE BACTERIOLOGY. By D. H. Bergey *et al.* (Baillière, Tindall and Cox, London, 1930. Price 27s.) A new and much enlarged edition.

118. MANUAL OF BACTERIAL PLANT PATHOGENS. By C. Elliott. (Baillière, Tindall and Cox, London, 1930. Price 22s. 6d.) Presents in alphabetical order causal organisms, description, synonymy, symptoms, host distribution, and literature.

GENERAL BOTANY, BREEDING, ETC.

119. STUDIES ON THE TRANSPORT OF NITROGENOUS SUBSTANCES IN THE COTTON PLANT. V. MOVEMENT TO THE BOLL. By E. J. Maskell and T. G. Mason. (*Ann. Bot.*, xliv., July, 1930.)

SUMMARY.—A 1. On the basis of earlier work, a tentative picture of the transport of carbohydrates and organic nitrogen is put forward as follows: For nitrogen as well as for carbohydrate transport there seems to be a gradient basis. For carbohydrates the head in the leaf is apparently reducing sugars, while for nitrogen the head is residual N. Within the sieve-tubes all the soluble carbohydrates and all the labile forms of nitrogen, including protein, should contribute to longitudinal transport, the part played by each depending on the effective concentration gradient maintained, and probably also on the diffusion constant. The mechanism (possibly protoplasmic streaming) which is responsible for accelerat-

ing diffusion along the sieve-tubes should act impartially on all materials that are free to move. Movement from the sieve-tubes into other tissues, and *vice versa,* is presumably confined to crystalloid substances, and in the case of nitrogen there is some evidence suggesting that residual N is the most important fraction. The rate of movement out of the sieve-tubes should depend on the effective gradient of exit maintained.

2. In the present paper we consider this picture of transport in relation to some aspects of the uptake of material by the boll.

B 1. In the first experiment a study is made of the effect of removal of flower-buds and bolls on the carbohydrate and nitrogen content of the leaves and the stem tissues.

2. Removal of flower-buds and bolls was followed by an increase in concentration of carbohydrates and of nitrogen, not only in the bark, but also in the wood and the leaf. Removal of a "sink," the flower-buds and bolls, is thus similar in its effects to the isolation of another "sink," the roots, by ringing the main axis at ground level; and the results confirm the general conception of a gradient basis for the transport of nitrogen and carbohydrates.

3. The percentage increase in nitrogen content was greater than that in carbohydrate content.

4. Polysaccharides account for a large part of the carbohydrate response, but total sugars also show a well-marked response, mainly due to sucrose. Protein N responds particularly in the leaves and in the upper region of the bark. Crystalloid N shows a well-marked response in all regions, and the percentage increase in crystalloid N is, in general, greater than that in protein N. In the leaves the crystalloid N response is mainly residual N; residual N responds also in bark and wood, but except in the upper region of the wood the increases are small. The greater part of the crystalloid N response in the stem-tissues is due to asparagine. Nitrates are almost unchanged in the leaves, but show a fall in bark and wood of the upper region.

The results are in most respects similar to those obtained on ringing the stem near its base.

C 1. In the second experiment an attempt was made to elucidate the method of carbohydrate and nitrogen uptake by the boll. The uptake of carbohydrates and of nitrogen, and the drift of sap concentrations, were followed for seven days in fertilized and unfertilized bolls. Ovules and carpels were handled separately.

2. A marked difference as between fertilized and unfertilized bolls, in uptake of carbohydrates and nitrogen, and a definite divergence in the march of sap concentrations of certain compounds, became apparent in both ovules and carpels on the fourth day after anthesis.

3. Two types of change are distinguished as likely to lead to the increased uptake by the fertilized bolls: (1) an increased *rate of utilization* of the mobile compounds (*i.e.*, compounds that enter the ovules and carpels from the sieve-tubes); (2) an increased *ease of entry* for these compounds. In the first case the concentration of the mobile compound in the growing organ diminishes, the gradient of entry steepens, and the rate of uptake increases. In the second case the rate of movement for unit gradient of entry increases, the concentration in the organ increases, and transformation (growth) becomes in consequence more rapid. If both factors operate there may be no change in concentration.

4. Ease of entry cannot be exactly measured, since we do not know the effective gradients of entry. But from (1) the amount of carbohydrate (or nitrogen) transformed during any time interval, and (2) the mean amount present during that time interval, of any compound that is assumed to be the mobile compound, estimates may be obtained of rates of utilization. *Utilization indices* can be calculated in this way for each of the compounds studied, and informa-

tion is also available in each case as to the change of sap concentration during growth.

5. Applying these criteria to the results obtained for the fertilized and unfertilized bolls, it seems probable that the increased uptake of carbohydrate by the fertilized ovules and carpels is due to an increased ease of entry of sucrose, coupled with an increased rate of utilization. The concentration of sucrose remains low during growth, and maintains approximately the same level in fertilized and unfertilized bolls. In the case of nitrogen, the results strongly suggest that the greater uptake by the fertilized ovules and carpels is due to a higher rate of utilization of crystalloid N, producing a lower concentration and therefore a steeper gradient into the ovules and carpels. In the ovules this increase in rate of utilization and decrease in concentration is shown by asparagine and residual N, but in the carpels by residual N only. From a consideration of the gradients into the boll during growth it seems probable that for both ovules and carpels the residual N fraction, rather than asparagine, is the form in which organic nitrogen enters from the sieve-tubes. In addition to an increased rate of utilization of residual N there may also be some increase in ease of entry.

(Published with Part IV. [Abstr. **565**, Vol. VII.] as a separate Memoir by the Corporation. Price 2s. 6d., post free.)

120. NITROGEN ESTIMATION IN THE COTTON PLANT. (*Rpt. of Govt. Chemist, Sudan*, 1929, p. 20.) During the year 2,273 samples of the different parts of the cotton plant in its various stages have been received for the determination of nitrogen. The analyses were carried out on plants in connection with the nitrogenous fertilizers and water duty interaction experiments at Hosh 79 Medani and Hosh 12 Shambat. Results at Medani show consistent falling off of nitrogen content as the season advances, to a minimum in January. All parts of the plant showed marked differences of nitrogen content with the different treatments from early in the season. At Shambat the same minimum was shown, but differences did not become apparent until after the minimum had been reached. This work is being continued and extended during the present season.

121. THE MICROSCOPY OF THE VEGETABLE FIBRES. By H. Ellis. (*Text. Rec.*, xlviii., **569**, 1930, p. 36, and **570**, p. 29.) Deals (*a*) with the classification of fibres into groups to facilitate investigations, and (*b*) with the structure and method of preparation of seed hairs for microscopical examination.

122. COTTON PLANT: EFFECTS OF X-RAYS ON. By J. W. McKay and T. H. Goodspeed. (*Science*, **71**, 1930, p. 644. Abstr. from *Summ. of Curr. Lit.*, x., **16**, 1930, p. 435.) Cotton plants were grown from seed of a single plant in a highly selected strain of "Half-and-Half" cotton. Flowers of these greenhouse plants were emasculated the evening preceding anthesis, and the unopened anthers placed in gelatin capsules. X-ray exposures for periods of 4, 8, 12, 16, and 25 minutes were made the next morning, and the pollen, which by this time had escaped from the anthers, was immediately placed on the stigmas of emasculated flowers. The control flowers were manipulated in the same manner in order to compare the setting of fruit in the two series. Seventeen mature fruits yielding 311 seeds were obtained from X-rayed pollen × untreated eggs and a larger number of fruits from the pollinations involving untreated pollen. One-half of the seeds from X-rayed pollen were planted in pots in the greenhouse, and from this number twenty-one plants were grown to maturity. Plants from untreated pollen were grown as a control. It was originally noted that in the seventeen fruits obtained from treated pollen there was a decrease in number of seeds per fruit as the dosage became heavier. A further evidence that sterility was a by-product of the treatment is seen in the production of only twenty-one plants from over 150 seeds. In external morphology many of these twenty-one

plants differed from sister plants from untreated pollen. Among the more striking differences were the presence of twisted and deformed stigmas, anas tomosing leaf veins, peculiarities in leaf shape, fasciated and enlarged stems, incomplete flowers, and dwarfness in habit. Only twelve of the twenty-one plants produced fertile fruits, and seeds from two of these were empty. Three plants were obtained from seeds of the 14-minute dosage. One of these died before reaching maturity, and the other two failed to produce mature fruits. Seeds of "Half-and-Half" cotton are normally characterized by uniform size and by the fact that at maturity every fibre is attached to the seed. Of the ten fertile plants mentioned above, three produced seeds very much larger than the average size in the control, two of the plants produced seeds from which the lint was entirely free at maturity, and three produced seeds showing this character to a noticeable extent.

123. COTTON PLANT: GENETICS. By R. A. Fisher. (*Biol. Abs.*, **4**, 1930, p. 1324; from *Amer. Nat.*, **62**, 1928. Abstr. from *Summ. of Curr. Lit.*, **19**, 1930, p. 517.) A cotton mutant, Crinkled Dwarf, is completely recessive in the Sea Island group of cottons in which it is known to occur; when introduced into other species, in which it does not occur naturally, dominance is no longer complete. The Sea Island group apparently differs from other New World cottons in a number of modifiers which together function to render the mutant recessive.

124. OCCURRENCE OF "LINTLESS" COTTON PLANTS AND THE INHERITANCE OF THE CHARACTER "LINTLESS." By F. Griffee and L. L. Ligon. (*Jour. Amer. Soc. Agron.*, **7**, 21, 1929, p. 711. Abstr. from *Exp. Sta. Rec.*, 62, **2**, 1930, p. 124.) Lintless cotton plants—*i.e.*, with smooth seeds and practically no lint—were crossed at the Oklahoma Experiment Station with King, a cotton with linted, fuzzy seed and red-centred flowers. The lintless character seemed to depend for its expression on a single factor partly dominant to the normal, the heterozygous condition being linted smooth. This factor pair seemed to be inherited independently of the pair for petal spot *v.* no petal spot. The lintless character is suggested as the result of mutation. Natural crossing was estimated to have taken place to the extent of 19·35 per cent. on a single row from neighbouring rows, and likewise between plants in the row.

125. SHORT BRANCH, ANOTHER CHARACTER OF COTTON SHOWING MONOHYBRID INHERITANCE. By T. H. Kearney. (*J. of Agr. Res.*, xli., **5**, 1930, p. 379.) A useful paper with good literature list. The author states that few characters of the cotton plant are known to be inherited in a definitely alternative manner. An addition to the short list of such characters—short branch—is described in the paper.

A plant showing the character was discovered in 1924 in a field of Pima Egyptian cotton in Arizona. The fruiting branches of this plant were reduced to a single internode which was leafless or practically so. Frequently two or three of these branches appeared at the same node of the main stem. From one to three flower buds were borne at the summit of the single internode. The character has been expressed uniformly in the inbred descendants of the original short-branch plant during four generations.

A cross was made in 1926 between a plant of an inbred Pima family having normal fruiting branches comprising usually five or more internodes and one of the short-branch plants. Only two plants survived in the F_1 progeny of the cross, and these showed an intermediate condition, bearing fruiting branches of from one to three internodes. In the second generation there was segregation into three classes—short branch, intermediate, and normal or long branch. The proportions of the several classes suggested a 1:2:1 ratio, indicating absence of

dominance in the heterozygous condition. Third generation progenies were grown in 1929, representing two individuals of each of the presumably homozygous classes in F_2, and four individuals of the presumably heterozygous (intermediate) class. The short-branch and the normal F_2 individuals bred true, while all of the F_2 plants selected as being probably heterozygous produced segregating progenies. Taking the four segregating F_2 progenies as one population, the departure from a ratio of 1 short branch : 2 intermediate : 1 normal was insignificant.

The evidence seems complete that the expression of the character "short branch" depends upon a single gene, and that there is no dominance in respect to this character.

[*Cf*. Abstr. **4**, **12**, **37**, **40** above.]

126. A NOTE ON THE DETERMINATION OF THE AREA OF SURFACE OF COTTON SEEDS. By R. L. N. Iyengar. (*Year Book*, 1929, Madras Agr. Dept., 1930, p. 7.) The calculation of the area of surface either from the volume or weight of the seed has been shown to be defective. A property directly depending upon the surface area has been studied. Cotton seeds are immersed in liquid paraffin for five minutes and centrifuged for ten minutes to remove the excess of the adhering liquid. The increase in weight, other things being equal, should be proportional to the area of surface of the seeds. The error of the experiment has also been found to be low, and this method is concluded to be (for all practical purposes) both convenient and accurate for the determination of the relative areas of surface of cotton seeds.

127. FLOWER BUDS IN COTTON BOLLS. By J. W. Hubbard. (*J. of Hered.*, **21**, 1930, p. 275.) A cotton plant was found in a uniform field of Acala at Shafter, California, showing unusual characters. The boll contained only small abortive seeds, and the placenta was expanded around a large fruiting bud.

[*Cf*. Abstr. **74** above.]

FIBRE, YARN, SPINNING, WEAVING, ETC.

128. BRITISH COTTON TEXTILE EXHIBITION. (*Text. Rec.*, xlviii., **571**, 1930, p. 31.) Lord Derby has accepted an invitation to become president of the Cotton Exhibition which is to be held in London in February, 1931. The Guarantee Fund opened in connection with the Exhibition is making encouraging progress, and to date about four-fifths of the sum required have been promised.

129. TEXTILE SCHOLARSHIP. (*Text. Rec.*, xlviii., **569**, 1930, p. 82.) A new scholarship to the value of £175 a year for two years and £300 for a third year is being offered by the Textile Institute to students of either cotton spinning or weaving.

130. RESEARCH IN THE BRITISH COTTON INDUSTRY. By Dr. R. H. Pickard, F.R.S. (*Cotton*, xxxvi., **1740**, 1930, p. 24.) An interesting account of the work of the Shirley Institute, dealing with spinning tests, the "Combined Grading Test," immaturity and neps, and the various problems in connection with spinning and manufacturing on which the Institute is engaged.

[*Cf*. Abstr. **62** above.]

131. TEXTILE MILL LABORATORY. By R. H. Adams. (*Text. World*, **77**, 1930, p. 1878. Abstr. from *J. of Text. Inst.*, xxi., **7**, 1930, A 379.) The requirements and work of a textile-testing laboratory are outlined, and a plan is given of a laboratory that has proved to be thoroughly practical for routine testing.

132. THE WEIGHT PER INCH OF FIBRES OF DIFFERENT LENGTHS AND THE NUMBERS OF FIBRES OF DIFFERENT LENGTHS PER SEED, FOR EACH OF THE STANDARD INDIAN COTTONS. By R. L. N. Iyengar and A. J. Turner. (*Tech.

Bull., Ser. B., No. 7, 1930, Indian Central Cotton Committee.) The object of the investigation has been to determine the values of the fibre-weight per unit length for different lengths of fibre of a given cotton, with a view to ascertaining whether any differences therein affect the value of the mean fibre-weight as determined by the ordinary cutting method, in which any such differences are ignored. The work has been extended so as to make possible the calculation of the average number of fibres per seed for each cotton.

The material for investigation consisted of eighteen standard Indian cottons and five American cottons. The seed-weight and lint-weight per seed were determined for a weighed amount of *kapas* (seed cotton) of each Indian cotton; the ginning percentage was then calculated; the lint was used for the determination of the percentage distribution of length by the Balls sorter, and for the determination of the fibre-weight per centimetre as follows: by means of the Baer sorter, fibres of different lengths were grouped together, the centimetre-lengths were cut from each group, and the fibre-weight per centimetre was determined for each group-length.

From these tests the following conclusions are drawn:

(1) It cannot be accepted as universally true that the fibre-weight per unit length is the same for different lengths of fibre of a given cotton.

(2) For the *hirsutum* cottons, the fibres of longer lengths of a given cotton generally have less fibre-weight per inch.

(3) The *herbaceum*, *neglectum*, and *indicum* cottons do not generally show any great change of fibre-weight with fibre-length; the chief exceptions are Aligarh A. 19 and Mollisoni, both of which have in each season a much less fibre-weight in the longer lengths.

(4) In spite of the variation of fibre-weight with fibre-length in some cases, the effect upon the mean fibre-weight is not sufficient to make this essentially different from the value obtained by the ordinary cutting method, in which any such variation is ignored. But there still remains the possibility that the cutting method may give rise to erroneous results owing to the variation of fibre-weight along the length of a single fibre.

(5) The number of fibres per seed may differ greatly for different species, for different varieties of the same species, or for the same variety in different seasons.

(6) For a series of cottons differing from one another not only in their conditions of growth, but also in variety and species, there is no direct proportionality between the number of fibres per seed and (1) the lint index, (2) the ratio of the lint-weight per seed to the seed-weight, or (3) the ginning percentage.

133. Studies in the Sampling of Cotton for the Determination of Fibre-Properties. I. Introductory and Experimental. II. Frequency-Curves for Various Fibre-Properties. By R. S. Koshai and A. J. Turner. (*Tech. Bull.*, Ser. B., No. 6, 1930. Indian Central Cotton Committee.) *Part I.*—It is pointed out that for the determination of the value of any fibre-property of a cotton, a small sample has to be selected for the experiment. Three questions, therefore, arise, viz., (1) how we may obtain a satisfactory sample, (2) how many fibres constitute a satisfactory sample, (3) what is the degree of reliability of the results obtained for the value of a fibre-property? The present investigation has therefore been undertaken primarily with a view to obtaining satisfactory answers to these three questions for the following fibre-properties—length, width, number of convolutions, strength, and rigidity. The tests of these properties have been made on some 3,000 fibres of Surat 1027 A.L.F., 1926-27; the description of these tests and the discussion of the results is divided into four parts, the first two parts forming the present paper. Part I. is introductory, and contains also a description of the experimental methods used for the measurement of the fibre-properties. Part II. deals with the frequency-curves for the various fibre-

properties. Part III. will deal with the three questions of sampling in the light of the results discussed in Part II.; and Part IV. will deal with the inter-relationship of the different fibre-properties.

Part II.—The answers to the questions formulated in Part I. depend upon the manner of distribution of the test-values. Frequency-polygons are drawn to indicate the various frequency-distributions. But as the results obtained relate only to comparatively small samples, theoretical continuous frequency-curves have been drawn by a recognized method to give the closest possible degree of fitting to the frequency-polygons. It is found that the frequency-distributions for fibre-length and convolutions are moderately symmetrical and nearly normal; for fibre-width, symmetrical and practically normal; for fibre-strength, moderately asymmetrical; and for fibre-rigidity, extremely asymmetrical. The causes of the asymmetrical distributions of fibre-strength and fibre-rigidity are discussed at some length, and are finally ascribed either to a change in the external conditions of growth during the life-history of the plant, or to the mutual interference of the fibres under the ordinary conditions of their growth.

An appendix is given explaining various statistical terms and methods used in curve-fitting, with detailed examples of their applications to fibre-properties.

134. THE FOUNDATIONS OF YARN-STRENGTH AND YARN-EXTENSION. III. THE CLINGING POWER OF COTTON. By H. Navkal and A. J. Turner. (*Tech. Bull.*, Ser. B., No. 8, 1930. Indian Central Cotton Committee.) The present paper describes tests to determine the clinging power of certain standard Indian cottons which had given spinning-test results that were somewhat unexpected in view of their other fibre-properties. The method used was a modification of Adderley's, and consisted of pulling a group of ten fibres of a cotton between pads made from parallelized fibres of the same cotton and subjected to a known pressure; the pads were $\frac{3}{8}$ inch long; the force was applied and measured by means of an O'Neill's fibre-strength tester. The clinging power is taken to be the force required to pull the ten fibres through the pads under a known pressure. The various sources of errors are discussed, and the conclusion reached that these are not serious.

Some preliminary experiments were made to determine the effect of differences of pressure between the friction pads, and finally a load was chosen to produce such a pressure as would not differ greatly from that experienced by the fibres of a yarn on the point of breaking under tension. This load was used in all the subsequent experiments. The following are the conclusions reached in the experiments on various standard Indian cottons using standard pressure between the friction pads.

(1) The clinging power depends upon the pressure acting on the fibres, increasing as the pressure increases, though the relative magnitude of the increase is not so rapid as that of the pressure itself.

(2) The cottons which are suitable only for comparatively low counts tend to have a high individual clinging power; it is possible that this property is partly responsible for the irregularity of the yarns spun from them, and for the impossibility of spinning them economically to a high count.

(3) There is comparatively high correlation between the highest standard warp counts and the clinging power of the whole fibre per unit fibre-weight per inch, showing that there is a tendency for those cottons which have high clinging power in relation to their length and fineness to be spinable to a comparatively high standard count.

(4) The clinging power per unit fibre-surface shows less variation than the clinging power or the clinging power of the whole fibre per unit fibre-weight per inch; and it appears that even if the clinging power per unit fibre surface

is not the same for different cottons, it is, at any rate, a property which is unrelated to the highest warp counts to which a cotton can be spun.

(5) The shorter and coarser cottons tend to have higher individual clinging power, but in the yarn the greater number of the finer and longer fibres present offsets the greater individual clinging power of the coarser fibres, so that the finer fibres actually have a much higher total clinging power in a yarn of a given count.

135. The Foundations of Yarn-Strength and Yarn-Extension. IV. The Influence of Yarn-Twist on the Diameters of Cotton Yarns, and on the Proportion of Fibre-Slippage and Fibre-Fracture in Yarn-Breakage. By A. N. Gulati and A. J. Turner. (*Tech. Bull.*, Ser. B, No. 9, 1930. Indian Central Cotton Committee.) Experiments are described to ascertain the relation between the strengths of yarns prepared with different degrees of twist, and the relative proportions of fibre-breakage and fibre-slippage which occur at yarn-breakage. Measurements have been made on the five cottons, 1027 A.L.F., Punjab-Americans 4F and 289F, Umri Bani, and Nandyal 14, in three different counts—viz., 20's, 30's, and 40's; and on Mollisoni in 10's counts. The tests were made on specimens of yarn 3 inches long; each test-piece was given a certain twist; its breaking strength, its weight, and the numbers of fibres breaking and slipping respectively at yarn-breakage were determined, and also the fibre-weight of the fibres constituting the yarn. Measurements were also made of the diameters of the yarns at the different degrees of twist. Each cotton was spun in the form of mock-grandrelle yarn to permit of the twists being counted in the 3-inch specimens of yarn by means of a lens. A testing-machine is described which was adapted from a twist-testing machine and used for inserting or removing any desired amount of twist, and also for determining the strength of the yarn. Experiments were made at nine different degrees of twist—viz., from 10 to 90 turns per 3-inch length—at intervals of 10 turns. Twenty specimens were tested at each degree of twist; only specimens were selected which appeared to the eye to be regular in diameter throughout the 3-inch length.

The following conclusions are drawn from these experiments:

(1) The diameter of a cotton yarn of a given twist per inch (n) and count (c) falling within the 20's to 40's range can be obtained by substituting the values for the counts and twist in one of two formulæ, neither of which contains any arbitrary constants. The simpler formula, that the diameter in millimetres equals $1{\cdot}9\ \sqrt{c}.\ \sqrt[4]{n}$, applies over the practical range of twists, but not at low twists.

(2) A cotton-yarn suffers only a slight change in diameter when it is placed under tension.

(3) The distribution of twist in a yarn of varying diameter is such that the number of turns of twist in any part of the yarn is approximately inversely proportional to the number of fibres in that part; as a consequence of this unequal distribution of twist, the diameter of the yarn at any given cross-section is directly proportional to the number of fibres at that cross-section.

(4) When only uniform specimens of yarn are tested for strength, the strength of the single yarn increases with the twist in 10's to 40's yarns until 30 turns per inch have been inserted. The most rapid increase for 20's and 30's yarn is between 7 and 17 turns per inch; for 40's yarn the most rapid increase of strength is between 10 and 13 turns per inch. The influence of twist is so small at low twists that up to 7 turns per inch the breakage of the yarn takes place almost entirely by fibre-slippage.

(5) The maximum yarn-strength values of the individual cottons do not reflect their highest suitable warp counts; it is therefore concluded that some

of the fibre-properties are important not so much for the strength they confer at the place of breakage as for the fact that they determine the frequency and degree of thick and thin places in the yarn.

(6) There is a very close relation between the percentage of fibre-fracture and yarn-strength, over 60 per cent. of the fibres breaking at high twist when the yarn-strength is at its highest, and very few fibres breaking at low twist when the yarn-strength is very small indeed.

(7) The values for the percentage of fibre-strength utilized, as calculated from the single-thread strength in relation to the product of the fibre-strength and number of fibres in the cross-section, show that in some cases the percentage actually exceeds 100. The existence of these high values is attributed to the deliberately biassed selection of the specimens of yarn used in the testing, by virtue of which full scope is given for the display of the accession of strength possible by doubling together a number of fibres whose strength varies greatly along their length.

[*Cf.* Abstr. **69** above.]

136. The Extensibility of Cotton Hairs. By G. E. Collins. (*J. of Text. Inst.*, xxi., **7**, 1930, T 316.) Observations have been made on the extension and recovery of single hairs from a sample of cotton that had been soaked in caustic soda solution to smooth out the convolutions. All the hairs were subjected to the same load, and measurements were made of the mean diameter and length, initially, after loading, and after removal of the load. The observations were conducted at a series of humidities ranging from zero to 100 per cent., and 25 hairs were tested at each humidity.

137. The Length Changes of Cotton Hairs in Solutions of Caustic Soda. By M. A. Calvert. (*J. of Text. Inst.*, xxi., **7**, 1930, T. 293.) This paper presents an investigation of the shrinkage of single cotton hairs not previously submitted to a swelling treatment, when immersed in caustic soda solutions of definite concentrations under a wider range of conditions than has been covered by previous workers. In Section II. the results obtained are reviewed, and the experimental methods and tables of data are given in Section III.

138. The Moisture Relations of Cotton. VII. A Study of Hysteresis. By A. R. Urquhart and N. Eckersall. (*J. of Text. Inst.*, xxi., **10**, 1930, T 499.) Deals with some aspects of the phenomenon that have hitherto not been described.

139. Cotton: Copper Number Determination. By A. Cremonini. (*Brit. Chem. Abs.*, B, 1930, p. 607 from *Annali Chim. Appl.*, **20**, 1930, p. 168. Abstr. from *Summ. of Curr. Lit.*, x., **16**, 1930, p. 436.) A more rapid procedure is given for determining the copper number of cotton, auto-reduction of the Fehling solution, and the use of the stirrer employed in Schwalbe's method being avoided. The air-dried cotton (drying at 100-105° sometimes increases the copper number) is heated in a boiling water-bath with diluted Fehling solution, and the cuprous oxide formed is determined either by means of ferric ammonium alum and standard permanganate or by means of standard thiosulphate and potassium iodide.

140. Cotton Yarns: Strength. (*Text. Weekly*, **5**, 1930, p. 384. Abstr. from *Summ. of Curr. Lit.*, x., **16**, 1930, p. 433.) Some of the rules and formulæ used for ascertaining the strengths of cotton yarns are given. It is pointed out that in the lea method of testing the results obtained with a power-driven machine are more reliable than those obtained with a hand-driven machine.

141. Cotton Constants at Given Percentage Waste Losses and Percentage Regains, Combined Together in One Constant. By W. H. Slater. (Obtainable Lancashire Statistical Service, 26, Cross Street, Manchester. Price 5s.

per copy, post free, or 6s. 9d. abroad.) This table of cotton constants should prove of service to cotton-mill managers, salesmen, merchants, brokers, and users of raw cotton, enabling them to find the cost of clean cotton in one pound of spun yarn with every fluctuation of the market price. The table has been designed to include both waste losses in cleaning and regain during conditioning at one costing operation; it is also capable of utilization in other ways. The whole is mounted on cardboard and varnished.

142. COTTON OPENING AND CLEANING MACHINERY. By Platt Bros. and Co., Ltd. (Oldham), and H. Wilkinson. (*Journ. of Text. Inst.*, xxi., **9**, 1930, A 492.) (1) In double cylinder cotton openers having two sets of feed-rollers, two long pneumatic tubes for conveyance of the fibre, and two sets of dust cages, cage-rollers, etc., the feed mechanism, dust cages, cage-rollers of the first section are periodically arrested before those of the second, whilst after stoppage the feed mechanism, etc., of the first section is automatically restarted slightly before the second. Details are given of the series of machines and the driving gear. (2) In openers with their feed-rollers, dust cages, cage-rollers, and long pneumatic tubes, a lifting lattice and feeding lattice, the elements are grouped into three units or sections, viz.: (*a*) A preliminary set feeding the material through a trio of members, and delivering to a hopper feed with spiked lifting lattice, and thence on to a horizontal or inclined lattice and feed-rollers; (*b*) cylinder opener with pneumatic tube leading to cages with cage-rollers, cylinder feed-rollers, etc.; and (*c*) cylinder opener with pneumatic tube leading to cages with cage-rollers, calender rolls, etc., the sections starting and stopping in the order (*a*), (*b*), (*c*).

143. COTTON OPENING AND CLEANING MACHINES. By C. A. Weston. (*Text. World*, **77**, 1930, pp. 3639 and 3689.) A general discussion of types of opening and cleaning machines, and the speeds and efficiency of various combinations.

144. COTTON LINTERS: APPLICATION. By W. D. Munson. (*Ind. Eng. Chem.*, **22**, 1930, p. 467. Abstr. from *J. of Text. Inst.*, xxi., **8**, 1930, A 412.) A general account is given of the production and purification of cotton linters, and their utilization in the production of rayons, films, lacquers, etc.

145. SPINNING MILL: REORGANIZATION. By H. Spibey. (*M/c. Guard. Coml.*, **21**, 1930, p. 123. Abstr. from *Summ. of Curr. Lit.*, x., 18, 1930, p. 495.) The suggestions relating to ring-spinning, high-drafting, high-speed winding and automatic looms in the Cotton Inquiry Report are discussed.

146. MECHANICALLY HARVESTED COTTON: SPINNING QUALITIES. By C. D. Brandt. (*Text. World*, **78**, 1930, p. 980. Abstr. from *Summ. of Curr. Lit.*, x., **20**, 1930, p. 533.) The mechanical harvester which strips off everything on the stalk provides the most rapid method of picking cotton. A test conducted in order to determine the effect of this method of harvesting on the spinning qualities of the cotton is described. In gathering cotton from the field, every second row of cotton was harvested by machine, while the rows between were hand-picked. Any chance of getting a difference in staple in the two lots was thereby eliminated. The two lots were subjected to identical conditions during processing; they were run through the same machines, at the same speeds, and with the same settings. Relative humidity was kept constant, and all other variables were eliminated. The results are given in graphical form. The total waste removed from the lot of machine-picked cotton amounted to 1·2 per cent. more than that removed from the hand-picked. It is evident, therefore, that the mechanical cleaning at present is not quite thorough enough. Even so, this small difference in cleanliness is said to be of little consequence. The final yarn produced did not show any noticeable difference in either cleanliness or evenness. Weft and warp yarns spun from the machine-picked cotton gave breaking strengths a little

higher than those for the corresponding yarns spun from the hand-picked cotton. [*Cf.* Abstr. 84 above.]

147. TEXTILE MILL: NOISE AND VIBRATION PREVENTION. (*Kunstseide*, 1930. **12**, *Achema-Heft*, 17-21. Abstr. from *Summ. of Curr. Lit.*, x., **15**, 1930, p. 403.) The reduction of noise and vibration of textile machinery by modifications in building construction and isolation of the machines is discussed. Standing machines on elastic pads of felt, cork, or similar materials is recommended. A reduction of vibration permits lighter construction and quicker running of machinery.

148. MAXIMUM PRODUCTION AT MINIMUM COST. By J. W. Hutchinson. (*Text. Rec.*, xlviii., **570**, 1930, p. 51.) Enumerates some of the many matters to which overlookers and weavers have to attend so that highest production may keep pace with the least expenditure.

149. HIGH DRAFT SYSTEMS: COMPARISON. By J. J. Tschudi. (Pamphlet *Das Hochverzugsstreckwerk*, 1930. Abstr. from *J. of Text. Inst.*, xxi., **9**, 1930, A 491.) A comprehensive and critical consideration of high draft systems, based on papers which have appeared in the *Leipziger Monatschrift fur Textilindustrie* and on the author's extensive experience. The conclusion to the pamphlet states that all investigations have confirmed the reduction of yarn strength with increasing draft, and, given a well-constructed system, a draft of fourteen for uncombed and twenty for combed cotton is a maximum. The structure of the yarn also becomes worse with increasing draft, and a device must be introduced to control attenuation or width of the sliver.

150. ROTARY LOOM. By F. Alonso. (*Times*, July 17, 1930. Abstr. from *Summ. of Curr. Lit.*, x., **15**, 1930, p. 394.) The loom is patented in the name of Patentes Textiles S.A., Bilbao, Spain. It weighs little more than 5 cwt., and the model weaving 65-inch cloth is 50 by 32 inch by 5 feet in height. The shuttle lies in a canoe-shaped cradle and is propelled by a series of rising fingers in circular formation. The fingers as they rise in turn push the shuttle forward in an endless rotary movement, at the same time performing the function of the reed on an ordinary loom. The speed of the shuttle depends entirely on the speed at which the fingers rise and fall. A comparatively small loom on view in Dundee has two shuttles with which it weaves 16 inches of 27-inch bag in one minute, a rate of production which is at least 100 per cent. faster than that of the ordinary flat-bed loom. The shuttle, which is everlasting, is made of aluminium and rests stationary in its travelling steel cradle. The number of shuttles used may be increased as the diameter of the loom is increased. It is claimed that the loom can work equally well with jute, cotton, wool, hemp, sisal, or any kind of fibre.

151. AUTOMATIC LOOM. By Wilson and Longbottom, Ltd. (*M/c. Guard. Coml.*, **21**, 1930, p. 180. Abstr. from *Summ. of Curr. Lit.*, x., **19**, 1930, p. 506.) Describes a new automatic loom for medium and heavy-weight cloths which is stated to be a relatively quiet-running loom.

152. AUTOMATIC LOOMS: APPLICATION. By J. W. Lord. (*Text. Weekly*, **5**, 1930, p. 360. Abstr. from *Summ. of Curr. Lit.*, x., **16**, 1930, p. 423.) The need of reconstruction in the Lancashire cotton industry and the advantages which would result from the application of automatic looms are discussed.

153. COTTON GOODS: APPLICATION IN ENGINEERING. By J. B. J. Higham. (*Mining Elec. Eng.*, 1929, **10**, p. 163, and **10**, 1930, p. 289. Abstr. from *Summ. of Curr. Lit.*, x., **15**, 1930, p. 396.) The paper describes briefly the cultivation and manufacture of cotton from its raw state to yarns and fabrics, giving a clear review of the sequence of operations and of the machines used. The applications

of cotton in engineering are summarized under the headings: electrical insulation, brake and clutch linings, gear wheels, belts and ropes, truck wheels and castors, road making, and proofing. A discussion is reported.

154. COTTON FISHING TACKLE: APPLICATION. By G. Meseck. (*Faserforschung*, 8, 1930. Abstr. from *Summ. of Curr. Lit.*, x., **19**, 1930, p. 514.) A review of materials used in Germany for fishing tackle. Cotton has advantages over hemp for nets in being smoother and easier to knit, in its smaller weight, its greater extensibility in the wet state, and in its softness. The disadvantage of cotton is the greater contraction taking place on wetting. Curves are given showing the fall in strength of cotton and hemp yarns on continuous wetting. The life of cotton nets may be increased by impregnating with suitable materials. Cotton has superseded flax for fishing nets.

155. COTTON ATHLETIC FIELD TARPAULIN. (*Text. Rec.*, xlviii., **569**, 1930, p. 77.) The growing use of the athletic field tarpaulin in America in the last ten years has increased the demand for heavy cotton canvas for that purpose to a present total of 500,000 yards, which may be doubled within the next decade. The usual material is 13 oz. standard army duck weave (canvas), which is waterproofed, and has an average life variously estimated at from three to ten years, eventual deterioration being due to moisture and chemical decomposition.

LEGISLATION

156. AUSTRALIA. *Cotton Industries Bounty Act, No.* 13 *of* 1930, July 8, 1930, provides for the payment of bounties on the production of seed cotton, lint and cotton yarn, and for other purposes.

157. TANGANYIKA TERRITORY. *Government Notice, No.* 92 of May 15, 1930, provides for the payment of fees to the District Officers by purchasers of native cotton in the Bukoba, Mwanza and Tabora Provinces. *Government Notice No.* 135 of August 1, 1930, enacts that the fees set forth in the Schedule to the Cotton (Fees) Rules (No. 2), 1929, shall be payable for the year ending March 31, 1931.

TRADE, CO-OPERATION, ETC.

158. CHANGE IN WORLD'S COTTON CONSUMPTION. By J. A. Todd. (*M/c. Guar. Coml.*, November 6, 1930.) The author states that the world's consumption of American cotton, after a big rise, is back again almost to the low point of the post-war depression, while the world's consumption of outside growths has risen pretty steadily throughout the whole period under review (1920-21 to 1929-30).

159. BRITISH COTTON INDUSTRY ORGANIZATION AND JAPANESE COMPETITION IN PIECE GOODS. By B. and H. Ellinger. (*J. Roy. Stat. Soc.*, **93**, 1930, p. 185. Abstr. from *Summ. of Curr. Lit.*, x., **16**, 1930, p. 441.) The authors review the conditions of Japanese competition with the United Kingdom in cotton piece goods, and urge the importance of large-scale amalgamations as a means of combating it. The questions of wages, freight, and mixing of cotton are discussed, and the organization of the cotton industry in Great Britain and Japan is examined.

160. THE SLUMP IN THE EUROPEAN COTTON INDUSTRY. By Dr. A. Niemeyer. (*Text. Rec.*, xlviii., **569**, 1930, p. 27.) Discusses the possibilities of international co-operation.

161. RECENT WORK ON COTTON MARKETING. By N. A. Olsen. (*Cotton*, M/c., xxxvi., **1740**, 1930, p. 33.) An authoritative statement dealing with research

studies, service work, and regulatory activities. The cotton marketing work is concentrated in the Division of Cotton Marketing in the Bureau of Agricultural Economics, U.S. Dept. of Agriculture.

162. THE LANCASHIRE COTTON CORPORATION LIMITED. By Sir Kenneth D. Stewart. (*Cotton*, M/c., xxxvi., **1740**, 1930, p. 30.) An account of the progress of the past year given under the heads of: Capital of the Corporation, Aims of the Corporation, Raw Cotton and Waste, Cotton Inquiry's Suggestion.

163. SKINNER'S COTTON TRADE DIRECTORY OF THE WORLD, 1930-1931. (London, Manchester, Bradford, New York, Montreal. 30s. net.) This is the eighth issue of this invaluable directory of the cotton trade. The thumb-holes for easy reference to the various sections are labelled: Contents (given in six different languages), Advertisers, Exporters, Merchants and Brokers, Waste Merchants, Spinners and Manufacturers—Great Britain, including a list of directors, etc., United States, Germany, France, Italy, India, China, Japan, Other Countries—Yarns, Piece Goods, Fabrics, Artificial Silk, Mill Supplies, Textile Machinery, Electrical, Chemicals. All the information under the various heads is given in the usual careful detail, with titles of firms, addresses, capital, number of spindles, etc. Substantial efforts have again been made to still further augment the information contained in the previous volume. The result has been that in the customary revision of all the details a large number of names have been added and valuable additions have also been made to the particulars already published, but whilst every endeavour is made each year to ensure that the details given are as up-to-date as possible, the period taken for the book to go through the press precludes the insertion of a considerable volume of new data. With a view to surmounting this difficulty the copyright of *The Textile Weekly* has been purchased, and in the columns of that journal will be found subsequent information which is received too late to be included in this Directory. Furthermore, it is intended to include each week in *The Textile Weekly* all particulars as published from time to time of Companies' Reports, Balance Sheets, and other essential information. The book is as indispensable as ever to all those in any way connected with the cotton trade.

HISTORY.

164. ANCIENT PERUVIAN TEXTILES. By L. M. O'Neale and A. L. Kroeber. (*Univ. California Publ. in Amer. Archæology and Ethnology*, **28**, 1930. Abstr. from *Summ. of Curr. Lit.*, x., **19**, 1930, p. 507.) A preliminary account is given of an investigation of prehistoric textiles from the coast region of Peru. Over 650 fabrics have so far been examined, and the results are condensed into a table showing the frequency of occurrence of the more important processes and devices in each culture—that is, in the textiles dating from a certain period in a certain valley. Both cotton and wool yarns were used in all periods; of the total number of specimens, 258 were of cotton only and 239 of cotton and wool.

165. ANCIENT PERUVIAN TEXTILES. By E. Rank. (*Kunstseide*, **12**, 1930. Abstr. from *J. of Text. Inst.*, xxi., **9**, 1930, A 498.) Primitive looms and fabrics found in the ancient tombs of the Inca region of Peru are described and numerous illustrations are given. Tapestries and knitted, woven, and embroidered materials, showing a wonderful range of designs based on geometric, plant, animal, human, and mythological motives, have been discovered. Fine shading and rich colours are found on the printed and dyed materials, and one type points to a process resembling the batik process. The light materials are of cotton and the heavier fabrics of llama and alpaca wool.

[And *cf*. Abstr. **80**, **164** above.]

MISCELLANEOUS.

166. Reports on the Work of Agricultural Research Institutes and on Certain Other Agricultural Investigations in the United Kingdom. 1928-29. (*Min. of Agr. and Fisheries*, London, 1930.) Contains summaries of work in progress at Agricultural Research Institutes, and reports on agricultural research in Northern Ireland and on investigations by research workers in England, Wales, and Scotland who are not attached to Research Institutes.

167. La Commission Internationale de Coordination pour l'Agriculture. (*Int. Inst. Agr.*, Rome, 1930.) This Commission is constituted by the official delegations of thirty-two international organizations, presided over by Senateur De Michelis. Its objects are to arrange the work of the various delegations and prevent overlapping, to fix dates of meetings, and generally to promote international goodwill.

168. Rationalization, by H. Martin Leake. (*Trop. Agriculture*, vii., 1930, p. 210, ending (4 articles) p. 274.) A detailed discussion of the whole question, referred to on page 33 above.

169. Death of Sir Francis Watts. With the death of Sir Francis Watts in Trinidad on September 26 is closed the career of one of the most prominent pioneers in the application of scientific methods to the growing of tropical crops. Almost the whole of Sir Francis Watts' life was devoted to tropical agriculture, and included many important Governmental appointments, beginning with that of Analytical Chemist in Antigua in 1889. He was appointed Imperial Commissioner for the West Indies in 1906, and in 1921 became the first Principal of the Imperial College of Tropical Agriculture. On his retirement in 1924 he was accorded the status of Principal Emeritus, and his valuable help and advice were still available to the College. One of his last services to tropical agriculture was his report on the Mauritius sugar industry, issued last March. Regret at Sir Francis Watts' death will be universal, but will be coupled with a feeling of thankfulness for a life of outstanding ability, a genial and kindly personality, and great achievement in the field of science.

ADDENDUM.

(Received on the eve of going to press.)

170. Nigeria. *Cotton Cultivation.* (*Half-yearly Rpt. of the Dpt. of Agr.*, to September 30, 1930.) *Northern Provinces.* The total purchase of American cotton for the 1929-30 season amounted to 34,389 bales, which is the nearest approach to the record of 37,356 bales for the 1925-26 season. A great increase in cotton growing has taken place in Sokoto Province, a comparatively new area opened up by the Gusau branch railway, and Southern Katsina, which is the main, and the most reliable, area for cotton, produced approximately the same amount as in 1925-26. There is thus every indication that, in spite of the unsatisfactory experiences of the last three seasons, the place of cotton production in the economy of the Northern Provinces has been steadily consolidated, and there is every reason to believe that with a year or two of better prices this improvement would be manifested in increased exports.

This season there is a reduction of 12 per cent. in the area planted to cotton, but considering the low prices ruling last year it is a matter of surprise to everyone concerned that the reduction is not of greater extent, and goes to confirm what has previously been said regarding the established position cotton now holds in

the economy of those districts—Southern Katsina and Sokoto—where it is chiefly produced. The crop generally looks well, and the gross production will probably not be very much less than last year.

Southern Provinces: Improved Oshan Cotton. The total purchases of this cotton (6,026 bales) exceeded all expectations, and the strain has proved a decided success. It is believed that had the Improved Ishan not been introduced, cotton production for export in the Southern Provinces would by now have been almost defunct—killed by low prices—but thanks to the new cotton the industry is holding its own even in these bad times. When prices rise again there is every reason to hope for a considerable increase in cotton growing in the Southern Provinces as well as in the North.

PERSONAL NOTES

OFFICERS ON LEAVE.

When an officer of a colonial Department of Agriculture (or of the allied departments of Irrigation, Transport, etc.) comes "home" on leave, he usually brings with him much information that may be of considerable value to similar officers in other colonies, or to the officers of the Empire Cotton Growing Corporation, who have to collect, collate, and use all possible information relating to cotton. The Corporation would consequently much appreciate the courtesy if Directors of Agriculture and others would be so kind as to inform them, in advance if possible, of the names, probable addresses, and approximate dates of arrival in England of officers coming on leave. This would give the Corporation the opportunity of getting into touch with these officers themselves, and of giving the latter the opportunity of meeting with one another. A further courtesy would be conferred if the officers themselves, upon arrival, would call at, or inform, the offices of the Empire Cotton Growing Corporation, which are at the corner of Millbank and Wood Street (entrance by the first door in Wood Street), immediately opposite the offices of the Crown Agents for the Colonies.

At the date of writing, the following officers are on leave in England from cotton-growing countries:

Ceylon	Mr. A. W. R. Joachim.
,,	Mr. W. C. Lester-Smith.
Gold Coast	Mr. J. E. Symond.
Kenya	Mr. W. O. Suman.
Nigeria	Mr. E. T. Holmes.
,,	Mr. J. E. James.
,,	Mr. J. R. Mackie.
Northern Rhodesia	Mr. W. E. Ford.
Nyasaland	Mr. E. W. Davy.
Sierra Leone	Mr. J. V. R. Brown.
Tanganyika Territory	Mr. J. F. Gabbutt.
,, ,,	Dr. G. B. Wallace.

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THE OUTLOOK FOR COTTON IN SOUTHERN RHODESIA

BY
G. S. CAMERON,
Cotton Specialist, Southern Rhodesia.

It is now three years since the writer last wrote in the EMPIRE COTTON GROWING REVIEW about the cotton-growing position in Southern Rhodesia, and it may be opportune if a few further notes are now contributed with the object of bringing the position up-to-date, and attempting to visualize as far as one can the prospects of the immediate and the more distant future.

In the intervening period, much has happened to enable us to sum up the prospects for and against the successful establishment of the cotton industry, the furtherance of which within our Empire is the sole reason for the existence of the Corporation.

Southern Rhodesia, as a whole, has had its periods of prosperity intermingled with set-backs and periods of depression, of which it is hoped that the one through which the whole world is passing at present may be but a phase. Yet, writing at a time when the outlook in every direction is anything but assuring, it is still possible to write about cotton-growing in this country in a spirit of optimism, optimism arising out of an innate conviction that a sound industry can be built up in spite of difficulties that have been encountered in the past, difficulties which are being encountered at the present time, and others which will no doubt arise as time goes on. It is very questionable whether such optimism would still be in existence but for the initial work of the Cotton Breeding Station at Barberton, and Parnell's discovery of the U. 4 variety of cotton.

In 1927 it was proved conclusively at Gatooma that, so far as Southern Rhodesia was concerned, only a jassid-resistant strain of cotton would have any chance of success in most years. This was

demonstrated by the behaviour of a small plot of Cambodia which stood out as a vivid green patch in marked contrast to all the other cottons on the Station; these had withered to the dark brown, shrivelled appearance characteristic of severe jassid attack. It seemed at that time as if straightforward selection work on Cambodia would be the surest way of building up a suitable seed supply for this country. In the same year, however, Parnell produced his U. 4 strain at Barberton, and kindly made over a quantity of about 15 lbs. of the seed, which was planted out at Gatooma at the beginning of the 1927-28 season.

From the behaviour of U. 4 at Barberton high hopes were entertained that it would prove suitable under Rhodesian conditions also. These hopes were realized in 1928, when the first multiplication of the 15 lbs. of U. 4 from Barberton resulted in about 1 ton of seed for distribution to farmers for still further multiplication, in addition to which a large number of selections were made for yield, length of staple, and other characters.

Attitude of the Farming Public.

It may be well to note here the attitude of the public towards cotton-growing as a possible industry for Southern Rhodesia. After the two successive failures of 1924-25 and 1925-26, the majority of farmers felt that as a crop cotton did not prove sufficiently remunerative to justify their continuing to grow it on anything but a very limited scale. This does not by any means imply that farmers had lost interest in the crop; in fact the reverse was the case. The question they kept asking was, "Why should cotton grow and yield as well as it did in 1923-24, yet behave so badly as it did the two following years?" The success of the 1923-24 crop whetted their desire to grow cotton, as it seemed to them that at last a crop had been found which grew well, did not require a large capital outlay, and made an excellent rotation with their principal crop—maize. Perhaps they did not realize that their initial success was due to what may be considered a rare combination of favourable circumstances—a combination not likely to recur at very frequent intervals. Possibly the most favourable factor was the high price at which they sold their crop—from sixteen to twenty pence per lb.; other contributory causes were favourable climatic conditions, and absence of severe insect attacks. In addition, it must not be forgotten that the individual acreages grown were small. Although the succeeding two seasons were not a success, they brought out one fact which the farmers dis-

covered for themselves, and that is the enhanced yields of maize which are obtained after growing cotton. Thus it came about that many prominent farmers reckoned that it would be worth while to grow cotton if only for its rotational value, and this explains why the sustained interest in cotton-growing has centred chiefly in the maize-growing districts, principally Mazoe, Hartley and Lomagundi. Deputations of farmers from these districts have visited the Cotton Breeding Station at Gatooma each year, and have evinced a keen interest in the progress of the Station. This was particularly noticeable in 1927, and again in 1928, when they saw the progress made with Cambodia and later with U. 4 cotton. On both occasions there was a marked absence of bollworm, so that the crops on the Station showed up extraordinarily well.

In 1928, when it became necessary to enlist the aid of farmers in bulking up U. 4 cotton seed, there was no lack of volunteers, and the ton of U. 4 seed produced on the Station was rationed out among some sixty farmers, who further increased the seed supply to 66 tons the following year. Each farmer had to sign rather a formidable-looking agreement, whereby, *inter alia*, he had to undertake to look after the crop properly, and at the end of the season return 75 per cent. of the seed to the Government at a fixed price of £5 per ton.

The one omission in the agreement—which was not discovered until too late—was that no limit was set as to the time when growers had to send in their seed cotton to be ginned. This caused a certain amount of inconvenience the following season, as one or two farmers did not appear to be in any hurry to send their seed cotton to the ginnery, and until they did so it was difficult to gauge the amount of seed which would be available for distribution.

In 1929-30 applications for seed commenced to come in as early as August, and by the end of November sufficient was issued to plant about 10,000 acres (the actual acreage planted being 6,134).

The amount of seed available did not permit of a heavy seed rate being employed. Subsequent experience has shown the 10 lbs. per acre actually issued to be far too low. In this connection it may be permissible to point out how easy it is to make mistakes of this kind. When, at the beginning of the 1928-29 season, the 1 ton of U. 4 cotton seed was issued to farmers to bulk up, the writer carried out a few germination tests, and noticed that the U. 4 seed took longer to germinate than did the old Improved Bancroft against which it was tested. Cutting open a number of seeds, it appeared that the U. 4 has a much thicker seed coat than Bancroft, and the writer feared that the germination on the farmers' increase plots would be

very low. As the seed had been issued, and much of it planted before the above facts were noticed, it was not possible to do anything in the matter. A hurried visit to a number of the farmers who were selected to multiply the seed, however, showed that the writer's fears were groundless, as all or nearly all the growers had secured a fairly good germination. When in 1929 it was decided to ration out the seed at the rate of 10 lbs. per acre, this was considered ample in view of results obtained the previous year with a seed rate of 2½ lbs. per acre. That the above decision was wrong was very soon made manifest by the number of complaints received of poor germination in the field. While enquiries showed that undoubtedly a certain amount of inferior seed had slipped through when making the issues, the evidence nevertheless was conflicting, as different growers obtained varying results even when using seed grown from the same crop the previous year. Such a state of affairs may be expected any year in a country where rainfall conditions vary as much as they do in Southern Rhodesia, even when good sound seed is planted, and this is further intensified by the vagaries of the soils, and the depths at which different farmers set their planting machines. Even after making due allowance for the above causes which tend to give varying germination results in the field, it is admitted that the seed rate was not sufficiently high. There appears to be but one solution to the difficulty of obtaining a good stand of plants, and that is to use a high seed rate. This practice is very strongly advocated now, and cotton growers are urged to plant not less than 25 to 30 lbs. per acre, and even more in cases where the seed appears to be of very low germinating capacity.

The poor stands obtained a year ago have led to a closer examination of the seed supply this year. A large number of germination tests have been made, and results, so far, go to show that the advice given in regard to employing a heavy seed rate has been fully justified. Investigations are still in progress, but already there appear to be indications that the chief cause of poor germination of cotton seed in this country is the result of stainer attack (*Dysdercus* sp.). There also appears to be evidence that seed can be badly affected by stainer without any apparent staining of lint.

Last year's crop (1929-30) may be considered the first large-scale trial of U. 4 cotton in Southern Rhodesia, and though results were not quite up to expectations, they were good enough to justify a still larger acreage being planted during the current season.

The final yield of seed cotton received at the ginneries amounted to 1,777,238 lbs., which works out at an average yield of 289 lbs. of

seed cotton per acre. Not a good average yield, it is true, but it constitutes a very distinct advance over former years, with the exception of 1923-24, when such good results were obtained throughout the country.

It is safe to say that the chief trouble last year was American bollworm, which probably accounted for upwards of 50 per cent. loss. At the same time it is well to remember that the combination of indifferent seed and low seed rate per acre, resulting in poor stands in the field, played a very large part in the low yields per acre obtained —a condition of affairs which need not happen in future, as the latter difficulty, in particular, is easily surmountable. Late planting, in many instances, and lack of attention to the crop on the part of a number of less progressive farmers, also contributed to lowering the yields.

AVERAGE YIELDS PER ACRE OBTAINED FROM 1923–24 to 1929–30.

Season.	*Acreage Planted.*	*Average Yield per Acre Seed Cotton.*
1923–24	3,947	428
1924–25	62,858	93
1925–26	66,086	124
1926–27	8,134	90
1927–28	1,340	85
1927–28	(U. 4 cotton seed increased from 15 to 2,000 lbs. on Cotton Breeding Station)]	
1928–29	(Above ton of seed increased by farmers to 66 tons)	
1929–30	6,134	289

The season was not considered very favourable to cotton-growing, but there is no need to stress this point, as the seasonal factor is one over which the grower has no control. Suffice it to say that, though the seasons have varied considerably in the last six years, some being favourable and some otherwise, it is felt that in none of them should cotton have failed from climatic conditions alone, had the country been in possession of a suitable seed supply. To rectify this state of affairs has been the chief aim of the Corporation's staff, aided and encouraged in every possible way by the Government of the country. It is claimed that a great advance has been made in the right direction, but further improvement is necessary before cotton can be considered as safe a crop to grow as maize or tobacco. The principal crop of the country is maize, but the writer has all along held the view that this crop has been in a precarious condition owing to a number of factors which need not be enumerated here. The whole position of the maize industry has recently been investigated by a Committee of Enquiry, whose findings have been set forth in their official report dated November 28, 1930.

The Maize Enquiry Committee has recommended a scheme of control whereby maize is to be sold locally at an agreed price, which will be greater than the export price of maize so long as the latter remains at its present low level. It remains to be seen whether the Government will adopt the scheme suggested by the Committee, and whether, if adopted, it will remedy affairs to the extent anticipated. Fortunately for cotton there is no likelihood of the crop being subjected to schemes devised to bolster up the industry artificially, so that if it is going to succeed it will have to do so on its own merits, a state of affairs which should tend to give it greater stability in the long run.

Costs of Production.

In Southern Rhodesia cotton is produced, so far, by white farmers who employ native labourers to do the actual field work. A full-grown native labourer is paid at the rate of about 17s. 6d. per month, plus food. Young boys (piccanins) are paid from about 10s. per month plus food, while drivers in charge of teams of sixteen oxen get as much as £2 per month, also plus food. In giving production costs the majority of farmers take into account only the actual cash outlay as represented by native wages, cost of seed, fertilizers, and wool packs. On this basis the production costs per acre work out in the neighbourhood of about 30s., more than this in some cases and less in others. It is felt, however, that a true estimate of production costs cannot be obtained without taking into consideration interest on value of land, interest and depreciation on implements, working oxen, supervision, overhead and other miscellaneous charges. What these will amount to it is difficult to say, as they will vary from farm to farm, and it will not be possible to obtain accurate figures until a system of strict cost accounting becomes more general among farmers than it is today. On one estate, however, situated 40 miles from the railway, the following costs were obtained in the season 1928-29, on a cotton patch of 24 acres:

	£	*s.*	*d.*
Transport	10	0	0
Repairs	1	8	8
Rent and interest	3	15	0
Expended stores		17	9
Sundry expenses	3	10	0
Depreciation	6	12	6
	£26	3	11

This works out at £1 1s. 10d. per acre, but it should be noted that the estate in question is situated 40 miles from the railway, whereas

the majority of farms are situated within distances of from 15 to 20 miles. The Rhodesia Railways have since instituted a system of Road Motor Service which has reduced transport costs considerably. The transport and depreciation charges appear to the writer to be on the high side. By taking the total overhead charges at £1 per acre, we obtain a figure which can be used as a basis in the absence of a better. If we take the cash outlay at £1 10s. per acre, plus £1 per acre for depreciation and other charges, we arrive at a figure of £2 10s. per acre, which may be taken as the approximate cost of production. This is over 6d. per lb. of lint on a yield like that of 1929-30. The local charges for ginning, pressing, and baling amount to 1½d. per lb. Railage to Beira, port charges, ocean freight to Liverpool, etc., amount to about another 1½d. per lb. If, therefore, the existing low prices are to continue indefinitely, it will be necessary for cotton growers to reduce their costs of production or increase their yields per acre. While it is doubtful whether much reduction can be effected in the annual cash outlay necessary to raise a cotton crop, it is felt that a considerable reduction in overhead charges can, and will, be made. This may necessitate much writing down of capital invested in land, a process which is bound to take place sooner or later, as the present-day value of land is out of all proportion to its production capacity. Transport is another item on which savings will be effected as time goes on, and the same may be said of the cost of agricultural implements and machinery.

With regard to the increase of yields per acre, there is good reason to hope for material progress in this direction within the next few years. The Cotton Breeding Station at Gatooma has produced improved strains from U. 4 re-selections, which show a marked advance in yielding capacity over the ordinary U. 4, while at the same time much is being learned about cultural methods, particularly in regard to closer spacing, and the employment of a heavier seed rate. The combination of these two factors should, in itself, constitute a distinct advance. It has always to be borne in mind, however, that it takes time to breed up new and improved strains, and some additional time to get these strains into general cultivation.

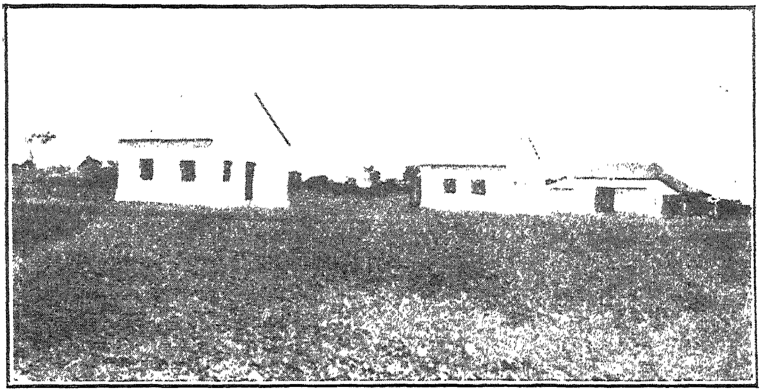
Distribution of Improved Strains.

In this latter respect the writer is convinced that we in Southern Rhodesia have a very distinct advantage in that we have co-operating with us quite a large number of progressive farmers who take a real live interest in the furtherance of cotton growing, and who give us

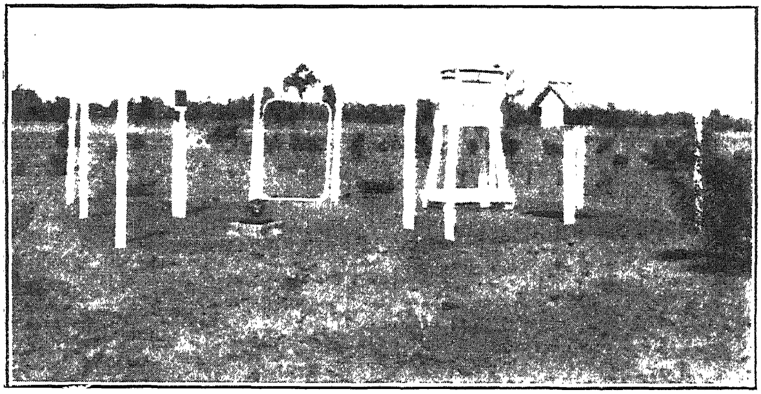
very material help in a number of ways. When it became necessary to evolve a scheme for distributing improved strains from the Cotton Breeding Station, these farmers were consulted in the matter, and it is largely through their approval and encouragement that our present scheme of distribution has been brought into operation. It consists of the sale of 10 lb. packets of seed selected at the Cotton Breeding Station. Each applicant is limited to one package, for which he has to pay £1. This figure appears to be very high, but it was fixed after consultation with many farmers, who agreed that it would be sound policy to charge a fairly high price in order to ensure the seed receiving the treatment it merited, and to ward off applications from people who are not really keen on cotton-growing. The scheme was inaugurated a year ago, and despite the high cost of the packets the demand exceeded the supply. This year there has been a slight falling off in the demand, owing largely, it is thought, to depressed conditions and the low prices which cotton is fetching today. Even so it has just equalled the supply, which is rather fortunate, as otherwise it would have been necessary to ballot for the packets, a procedure which is neither desirable nor satisfactory. The contents of one package will plant approximately 4½ acres if planted at distances of 3 ft. by 3 ft., using not more than two seeds per hill.

The packets are made of strong canvas duck, sealed with a lead tag, and despatched per registered parcel post, so that in the event of non-delivery it is possible to trace any missing packages. It is considered that this scheme is workable, popular with cotton growers, and is the most "fluid" method of distribution, as the packets can be sent, through the post, to the most outlying districts.

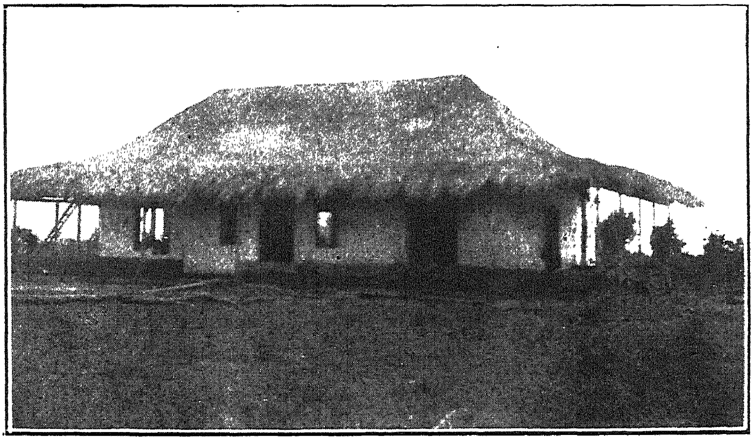
The seed plots last season gave very satisfactory results, and in many cases surprisingly good stands were obtained. With the wide spacing and light seed rate employed farmers have to be constantly reminded that results must be judged by the return of seed obtained, and not on a yield per acre basis. Nevertheless, it was found in many cases that high yields per acre were obtained, and the fortunate growers had good reason to feel pleased with the success of the scheme. At the same time it has to be remembered that seed multiplication is a tricky business, and there is always likely to be a small percentage of growers who will not succeed in getting a good germination, owing, in some cases, to difficult planting weather, and in others, it is to be feared, through lack of sufficient attention.



1.—MUD-BRICK AND IRON-ROOFED LABORATORY AND SEED STORE ON COTTON BREEDING STATION, BUILT BY FARM LABOUR.



2.—METEOROLOGICAL RECORDING INSTRUMENTS ON COTTON BREEDING STATION.



3.—PLANT BREEDER'S BUNGALOW. MUD-BRICK UNDER THATCH ROOF. BUILT BY NATIVE FARM LABOUR.

THE COTTON BREEDING STATION, GATOOMA.

In reviewing the present position of the Cotton Growing Industry in Southern Rhodesia, it is necessary to take into account the functions of the Cotton Breeding Station at Gatooma, and the part it has played in the re-establishment of the industry. But for the inauguration of this Station in 1925, it is very questionable if any cotton would be grown in Southern Rhodesia today. The position has been admirably summed up by the Minister of Agriculture and Lands, the Honourable R. A. Fletcher, M.L.A., in his introductory note to the portion of the "Reports received from Experiment Stations, 1928-29," which refers to Southern Rhodesia. He there stated: "Rhodesia, being a young country, is ever on the look out for fresh avenues for agricultural development, and in the past has at times, I am afraid, embarked on new crop-growing ventures with more enthusiasm and enterprise than perhaps prudence would have dictated. The cotton-growing boom was one of these occasions, and the crop might well have been turned down in the reactionary spirit of disappointment which followed, but for the good services of the Empire Cotton Growing Corporation. Unobtrusively and methodically have the plant breeding experiments been carried on from season to season at the Gatooma Station, while interest in cotton as a crop has been kept alive by co-operation with a few progressive growers until ultimately suitable strains have been evolved and seed production developed."

Much has been said in the past, and unfortunately continues to be said in ill-informed quarters, about the losses which farmers suffered through cotton, but the writer is firm in the belief that really very few farmers suffered financial loss beyond a small number who gambled recklessly on the crop. Where the real loss came in was "in the reactionary spirit of disappointment," as the Honourable the Minister of Agriculture has so ably described the position. During one whole year the highest, most extravagant hopes were entertained, to be followed by sad disillusionment. No wonder so many farmers were bitter about cotton; but what many failed to realize was that it was their own unbounded enthusiasm which led them astray, and that, in reality, they were themselves to blame, and not the crop. Fortunately there were quite a number who realized that the sudden, one might say haphazard, introduction of a new crop is rarely attended by instantaneous success, and that much uphill work has to be done, and many disappointments encountered, before success is achieved. To them the establishment of the Cotton Station at Gatooma meant

hope for the future in that a successful industry might eventually be created on the ruins of what can now be looked upon as an over-optimistic and unjustifiable venture.

Had it not been for the work of the Cotton Station, causes which led up to the initial failure would never have been properly diagnosed, and the erroneous impression would have become firmly established that this country is not suited to cotton-growing. The real position is that, actually, Southern Rhodesia is admirably suited to cotton-growing, now that the right variety has been found, and no more convincing argument is necessary than the appearance of well-tended crops where they have escaped the ravages of bollworm attack. Any year in which bollworm is not severe, from now onwards, should show an increasing percentage of successful crops, while there are good reasons to hope that even the bollworm may be kept in check and controlled to a sufficient extent to permit of cotton becoming one of our most remunerative crops. It would not be possible to make such bold statements but for the careful and painstaking investigational work of the Cotton Breeding Station, where the nuclei of future cotton crops are selected, bred up, and distributed to farmers throughout the country.

The Attitude of the Government.

The Government of Southern Rhodesia has all along taken a sympathetic and broadminded attitude with regard to the possibilities of cotton-growing, and has assisted the Corporation to the full, bearing a large share of the financial burden. It has inevitably been subject to criticism—the common lot of Governments in democratic countries, especially in times of economic stress. Its policy of taking a partnership in three co-operative ginneries needs no defence, since this is in conformity with established practice in all countries where cotton-growing is of comparatively modern date. Further, the affiliation of the co-operative ginneries to the Central Co-operative Cotton Exchange in Durban has been without question a help to growers, and that from more than one standpoint.

An even more unreasonable criticism is that the Government did not damp down the enthusiasm of growers and prevent the boom from materializing. It is hardly necessary to point out that no form of Government can prevent the public from stampeding once the public has taken the bit in its teeth. Cotton is, unfortunately, by no means an isolated case.

It can be truthfully stated that the Southern Rhodesian Govern-

ment has always taken a sane view of the prospects of growing cotton in this Colony. Its members realize full well what it will mean to the general prosperity of the farming community if cotton can be made a successful crop, and while they have many other affairs to consider they have always taken a keen interest in our work, to which they have given generous financial support.

Immediate Prospects and Further Possibilities.

Although one writes with confidence about the future prospects of cotton-growing in Southern Rhodesia, the whole issue is momentarily obscured by two outstanding problems. First of all there is the bollworm menace, and secondly, but to a less extent, the price of cotton in relation to other raw produce.

If one take up a defeatist attitude, and assume that the bollworm will be as bad in the future as it has been in the past, or that suitable means of control are beyond the range of possibility, then the outlook is not very promising. Even so it is not as bad as might appear at first sight. Given anything like a reasonable price, say 8d. per lb. for our cotton, the industry will go ahead in spite of bollworm troubles, as there is every reason to hope for increased yields as a result of improved strains emanating from the Cotton Breeding Station. Further improvement may reasonably be anticipated as growers become more experienced in cultural methods, particularly in regard to adopting a heavier seed rate and closer spacing.

From the very meagre amount of information at our disposal, however, we have no reason to presume that bollworm will always be as bad as it has been in the past two seasons, or that methods will not be evolved to counter its depredations to a certain extent. Already there are indications that the early broods at least may be checked by the use of arsenical dust. So far these are only indications, it is true, but as such they are well worth following up, and this is being done during the current season. If the early broods can be held in check the later ones are only likely to damage those flowers and squares which in all probability would not mature in any case. The possibility of control by means of egg parasites is very intriguing. In this respect the lead given by our colleagues in Barberton is being watched with the closest interest, and if they succeed, there is no reason to suppose that similar or slightly modified methods will not succeed in Southern Rhodesia.

What the future trend of prices is likely to be in the next few years is a question from which most people, advisedly, shy clear. As far

as this country is concerned, however, cotton, even at today's prices, should hold its own with other agricultural exports so long as they remain below cost of production, as they are at present. Despite the low prices at which the last cotton crop was sold, it is anticipated that there will be a material increase in this year's acreage put down to cotton, an increase estimated by some to be as much as 50 per cent. If this turn out to be the case, it goes to show that at least a fair number of farmers are regaining their confidence in cotton. Given one or two favourable seasons and we may again see the large acreages of 1925 and 1926, but it is hoped without the same disastrous results. As a fitting conclusion the following quotation is taken from a note by one of the former Ministers of Agriculture, the Honourable J. W. Downie, now High Commissioner for Southern Rhodesia in London: "The benefits to agriculture which will accrue from the establishment of cotton-growing as a part of the progressive farmers' regular rotation are more than can be visualized, but the advantages are already appreciated by many, and the co-operation between the Government of the Colony and the Empire Cotton Growing Corporation in the interests of the cotton industry augurs well for its future success. . . . I simply counsel patience . . . patience and confidence."

Received February, 1931.

COTTON TRIALS IN NORTHERN TERRITORIES, GOLD COAST

BY

T. LLOYD WILLIAMS, *Botanist*,

AND

J. E. SYMOND, *Superintendent of Agriculture.*

For many years efforts have been made to promote cotton-growing on a large scale in the Northern Territories, but no success has yet resulted on account of the very low yields obtained for all varieties tried.

In general the area used for these trials has been around Tamale. As far back as 1910 the British Cotton Growing Association erected a small ginnery there, distributed seed free amongst the natives, carried on propaganda, and bought seed cotton at ¾d. per pound. At this time the country had only recently been pacified, transport conditions were primitive, and the natives had very little use for money. After persevering for six years the Association was forced to close down owing to low yields and insufficient offer of cotton.

During this period, and until 1920, small trials carried out by the Department of Agriculture gave results varying from 46 to 247 lb. seed cotton per acre for the main variety used (Black Rattler), and for all the different types tried the highest yield on a small scale was 512 lb. per acre, the average being near 100 lb. Many of these plots, however, were regularly and heavily manured, an operation which would not be feasible for farmers generally.

In 1926 another attempt was made to develop the industry, and the more settled state of the country, the improved transport conditions, and the very much higher price which could be offered for the produce (2d. per pound seed cotton) raised hopes that the response would be greater. A power ginnery was erected, and several tons of Allen seed from Northern Nigeria were imported and distributed free. Field-scale trials with the same seed were laid down over 40 acres on the Agricultural Station, but the yields were very low—averaging only 20 lb. seed cotton per acre, partly owing to abnormal rains—and the response from the native growers in the district was poor. More seed was imported in the following season (1927-28) and the procedure repeated, but yields were very little better either on

the station or in the district. A commencement was then made with seed selection from the Allen variety.

In 1928-29 distribution of Allen seed was again carried out within a forty-mile radius of the ginnery, with the added inducement to farmers of a bonus of 10s. per acre for cotton grown as a pure stand—this, of course, in addition to the 2d. per pound for seed cotton. At the same time an investigation was started at Tamale Agricultural Station into the causes of the continued low yields of cotton in the Northern Territories, and many new varieties were imported. A careful survey was also made of all native farms within the radius, and the acreages measured. Although the response was much greater, and double the amount of seed cotton obtained the previous year was brought in, yet the average yield was a negligible improvement on other years. It became obvious, therefore, that the Government was involved in too great a subsidy, while there was little prospect of improvement or expansion; and it was decided that the promotion of cotton-growing among the natives should be left in abeyance till such time as investigational work should be successful in evolving, if possible, a comparatively high yielding strain which would withstand thorough tests on a large scale over a number of years. This work is by no means complete, but a brief review of the adverse conditions and of the progress made may be of interest. The results discussed are from two seasons' work only, and must therefore be interpreted with caution. A general review only is possible here, full details being given in the Year Books of the Gold Coast Department of Agriculture.

Climate and Soil.—The wet season is from March to October inclusive. From November to February it is practically rainless, and during these four months a dry desiccating wind from the north-east, known as the Harmattan, also blows. Rainfall records, which are available for the past twenty years, show an annual mean of 42 inches, with a maximum and minimum of 62 and 32 inches respectively. The total rainfall is generally near the mean, but the distribution is most erratic. The early rains are very variable; there is usually a short break about June or July, and from one-third to a half of the total rainfall may be expected to fall late in the season, followed almost at once by the onset of the drought and the Harmattan wind.

The soil of the district in general is of very light sandy nature, with a hard pan of semi-permeable laterite close to the surface. Below this, again, it is common to find impermeable shale, and in consequence during the height of the rainy season seepage water runs so close beneath the surface that excess moisture is inevitable. On the

cessation of the rains the soil naturally dries out very rapidly. Ridging is the universal native practice for crops.

VARIETIES TESTED.—The varieties tested include the following: CO 1, CO 1A, Griffin, Improved Bancroft F, Improved Bancroft D, Zululand Hybrid, Uganda, 440 variety, Improved B Barberton, Hartsville, Watt's Long Staple, Delphos 911, Express 121, Webber, American, D & PL No. 6, Ishan and Allen (from Nigeria) with various sub-strains, three native varieties from the Northern Territories, and two from further south called Ashanti and Sonko. Of all these varieties none has shown any promise, except the selections from Allen and Ashanti. These two and Ishan have been grown on a field scale. The Ishan was first considered promising on account of comparative resistance to boll-shedding, but it has since been rejected as it seems unsuited to the conditions, making a long straggling plant which does not yield highly, and matures very late.

CAUSES OF LOW YIELD.—Investigations have been carried out on the following characteristics of the main varieties tested:

1. Types of flowering, shedding, and harvesting curves, occurring under different conditions.
2. Incidence of pests and diseases responsible for shedding and damage.
3. Period from planting to flowering and maturity.

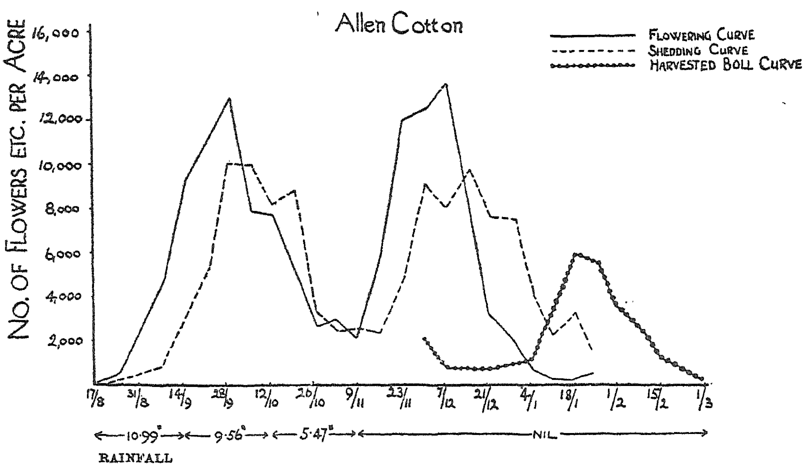
The common flowering curve consists of one or two distinct peaks during the wet season, dependent on the time of planting, and another peak occurring at the onset of the dry season irrespective of the planting date (*vide* Graph I). Late planting reduces very definitely the total number of flowers produced.

The shedding curves have been found to follow the form of the flowering curves closely with an interval of approximately one week. From the harvesting curves it is found that bolls set before the commencement of the dry season contribute practically nothing to the total yield on account of the extremely high shedding and damage which takes place. Shedding in Allen as high as 88·9 per cent. has been recorded, and 80 per cent. is usual. Bolls from the flowers produced in the peak at the commencement of dry weather constitute almost the entire harvest.

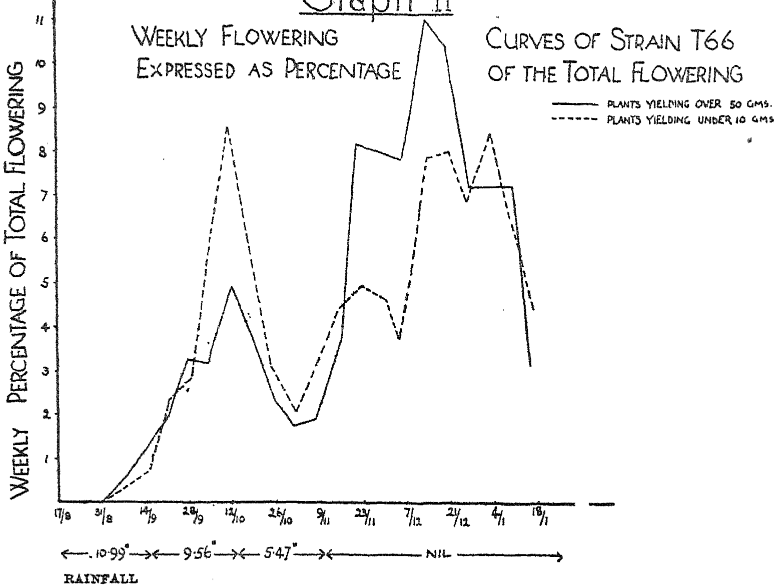
Experiments with pen manure have given double the yield of the control plots, but the types of flowering and shedding curves have not varied from those of the controls. The same almost complete shedding of all bolls set in the wet season occurs, but there is great stimulation in growth and total flower production, which accounts for the increased yield.

Graph I

TYPICAL FLOWERING, SHEDDING, AND HARVESTED BOLL CURVES. PLANTED 28.6.29.



Graph II



Daily classification of the shed bolls from a large number of sample plots has given very interesting results. From the data amassed, it was shown that the causes of shedding are approximately as follows: " Stainer," 12 per cent. of total bolls shed; " bollworm," 29 per cent. of total bolls shed; " physiological," 29 per cent. of total bolls shed; " other injuries," 34 per cent. of total bolls shed.

" Physiological " accounts for those bolls which show no signs of injury or disease, and " other injuries " includes all bolls showing signs of bacterial or fungus disease. Probably some of these are due to internal boll disease caused by stainer, but it is difficult to separate them definitely. Tables compiled of monthly incidence of pests and disease in shed bolls show that " stainer " and " other injuries " decrease rapidly as drier conditions set in, whilst bollworm remains constant till well on in the dry weather, when there is a sharp drop. Physiological shedding decreases immediately the dry weather commences, but rises again at the end of the season, and is then undoubtedly due to drought. The foregoing remarks hold good for different planting times.

In addition to the above, mainly in the dry season, a large number of small bolls shrivel up and " mummify," remaining on the plant. These amount to some 17 per cent. of the total bolls produced, excluding those harvested. Examination reveals that 75 per cent. of them show traces of bollworm attack, though the reason why they do not shed is at present obscure.

A careful analysis of harvested bolls revealed the fact that approximately 50 per cent. show bollworm damage, but there was evidence that the severity of the attack decreased in the latter part of the dry season. From the above it is advanced that the causes of low yield are the following:

1. *Excessive Moisture during the Height of the Rainy Season.* A large portion of the total rainfall within a short period cannot be readily drained off, provides optimum conditions for the spread of disease, and causes a high rate of physiological shedding.

2. *Insect Attack.* Stainer (*Dysdercus superstitiosus*) is not considered a serious pest, but bollworm, which causes 29 per cent. shedding, 75 per cent. of mummied bolls, and attacks 50 per cent. of harvested bolls, must obviously be considered a major pest.

3. *Soil Deficiency.* The very light sandy soil is obviously unsuited to the present varieties of cotton, and the response to manurial treatment is marked.

TYPE OF COTTON WANTED AND RESULT OF SELECTION.—Soil poverty is an unavoidable disadvantage. The best has to be made of what exists, and manuring is not considered feasible at present for the primitive people of the district.

Everything tends to show that it would be advantageous to grow cotton so that all flowers are produced from the commencement of drier conditions when disease and insect attacks wane, the former rapidly, and the latter to some extent. Late planting will not achieve this desirable result, owing to the poor development that the young plants make whilst struggling to exist in conditions of excessive moisture, and the great fall in total flower production in consequence. The aim must be to evolve a strain which has a comparatively long vegetative period in order to obtain a well-developed plant before the dry season starts. This must be followed by a rapid flowering season, in which as large a percentage as possible of the total flowers are produced in one peak. Selection work has been carried out on these lines, yield at present being considered of paramount importance; quality can be improved later.

The most successful results have been obtained with the "Ashanti" variety—an acclimatized American type of which the history is obscure—and the Allen variety obtained from Nigeria. Three strains from these show some promise at present (No. T66 from Ashanti, and T57 and D28 from Allen), and the characteristics of the parent plants are shown in the attached Table I.

TABLE I.—CHARACTERISTICS OF PARENTS OF STRAINS T57, T66, T75, T68 AND D28.

Plant No.	*Variety.*	*Total No. of Bolls.*	*Mean Weight per Bolls (Gms.)*	*Average No. of Locks per Boll.*	*Weight of Seed Cotton.*	*Lint Length. Paraffin Slide.*	*Type of Seed.*	*Ginning Percentage.*	*Vegetative Characters.*		*Remarks.*
									Height.	*Health.*	
T57	Allen Smooth	31	3·77	3·97	98·0	18·45	Smooth	33·20	3′ 0″	Medium	Nil
T66	Ashanti Smooth	100	2·67	4·02	243·7	17·31	Smooth	28·24	5′ 0″	Very good	Late maturing
D28	Allen	42	2·90	4·0	99·7	17·41	Fuzzy	30·0	4′ 6″	Very good	Nil

In the stage to which these strains have progressed, T66 has given the best results, and maintained its predominance as the highest yielding selection. From approximately a 50 per cent. stand it has yielded at the rate of 273 lb. of seed cotton per acre, so that it would appear quite reasonable to expect 300 lb. on a field scale. It may here be mentioned that none of these selections have been accorded

preferential treatment in any way; indeed, they have been grown on land somewhat below the average. Low though this yield is for cotton, it is so great an improvement on any previous results for unmanured cotton that the writers consider that it will prove economically attractive to farmers if it can be maintained on a field scale.

The other selections have not so high a yield, T57 and D28 on the same 50 per cent. stand giving 166 and 100 lb. respectively. They are of slightly better quality, and the latter strain, after having been selfed for two years, is nearly pure. Strains T66 and T57 are still somewhat impure, noticeably in their seed characteristics. Both arose from naked seeded plants (which appears as though the Allen seed was impure), and are now splitting up into naked and fuzzy seeded types. This is occurring in what appears to be a simple Mendelian ratio, with naked seed dominant, as may be seen from the following table:

	Smooth tufted	Semi-fuzzy	Fuzzy
	55	17	21
For T57.	72		21
	Expectation on a simple Mendelian ratio		
	69·75		23·25
	Smooth tufted	Semi-fuzzy	Fuzzy
	61	23	36
For T66.	84		
	Expectation as above		
	90		30

Analysis of individual plant yields in the strain T66 showed that the twenty highest yielding plants—16 per cent. of the total—gave 42 per cent. of the total yield. It was most encouraging to find that these high-yielding plants also approached most nearly to the required flowering curve as discussed above, though the whole strain is constant to comparatively late maturity (*vide* Graph II).

Conclusion.

The writers consider it improbable that cotton, even if successful, will be grown as a pure stand by natives for many years to come. At present food crops are the more profitable, but cotton is normally grown as a minor intercrop, and if a comparatively high yield can be maintained the area would be much increased. Lack of population would unfortunately be a limiting factor at present to any very large production.

At present no attempt is made by the natives to control pests or to improve cotton. Ratoons are frequently allowed to grow, and at harvest time the farmers rarely uproot their plants until the land is wanted for some other purpose. There is, in consequence, an easy carry-over for any insect pest. Extension work with an improved strain will naturally have to be very carefully controlled, and the Department will possibly have to seek powers securing that sanitation of farms containing cotton is properly carried out.

The writers have quoted from the Annual Reports and Year Book of the Department of Agriculture, containing the work of Mr. C. Saunders and Captain G. Coull, for all results previous to the 1928-29 season.

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SPEEDING UP PLANT BREEDING

BY

DR. C. C. HURST.

DURING the next few years we may with some confidence expect a considerable revolution in our present methods of plant breeding. The science of Genetics has taken a great step forward during the last five years in the discovery that X-rays and other radiations may be used in the rapid production of new varieties; and a new field of vast possibilities lies open before us.

It is now thirty years since the rediscovery of Mendel's long-lost paper gave such a tremendous impetus to the study of heredity, placing the science of breeding upon a firm basis of scientific fact proved by experiment. The immense possibilities latent in the application of Mendelism to plant breeding were at once seen, and experiments of a practical nature were quickly set on foot. The rapidity with which any particular character or combination of characters of a desirable nature could be fixed in a given stock was a revelation, and today there are few economic plants which have not been subjected to this scientific treatment, to their great improvement in all directions. Our wheat, sugar-cane, and cotton crops have especially benefited by the application of Genetics.

In all these cases, however, these desirable results have been brought about by the bringing together, into new combinations and recombinations, of characters already existing in different varieties. To get new characters of value one must wait for the very rare occurrence of favourable mutations whereby an old character is changed into a new and better one. Such a case arose in the Florida bean, which suddenly produced a mutation that made the new variety more hardy, so that it could be grown in more diverse climates and was thus fitted for cultivation over a much wider area than had been possible before. Such fortunate mutations, however, are extremely rare in Nature, and only turn up in the ordinary way once in a generation or so. Four years ago a new and surprising development in regard to mutation took place when Müller, by application of X-rays to the little fruit fly (*Drosophila*), succeeded in producing at will hundreds of mutations of a similar nature to those which had previously occurred in the breeding experiments of Morgan and

others. In other words, by the use of X-rays Müller reproduced in a few minutes the mutations that had taken seventeen years to accumulate in previous breeding experiments, as well as other mutations which were quite new to science. Compared with the untreated controls the use of X-rays increased the rate of mutation about 150 times (an increase of 15,000 per cent.). These mutations brought about by the agency of the X-rays were exactly the same types as those which arise in normal cultures and in Nature. The great majority of these mutations, of course, are quite useless, many of them being unviable and lethal;* but on the other hand a few are really good, viable, and progressive, and a distinct asset to the species. Plant breeders were not slow to follow up Müller's remarkable results with insects by applying X-rays to plants. Already many experiments have been carried out with wheat, oats, barley, maize, tobacco, sugar-cane, and cotton, and the results are exceedingly promising.

It is now only a question of time before X-rays are applied to all our crops and to the raising of new and improved horticultural varieties. During the next ten years we may expect to see a revolutionary speeding up of plant breeding by the use of X-rays, and it is quite possible that in the next twenty years more new and improved varieties of crop plants may be created than have arisen naturally in the whole of man's cultivations during the last 7,000 years. Here at last man seems to have discovered the means whereby he can control evolution and proceed to create new varieties, species, and even genera of plants and animals. Through long ages of secular time these random chance mutations have been occurring in Nature, as previously postulated by Darwin, and in accordance with the principles of Natural Selection those best fitted and adapted to the environment have been preserved, while the unfit and ill-adapted have been washed out.

It is evident that in the use of X-rays, and to some extent of other short-waved radiations, we have a valuable discovery in the speeding up of the production of new varieties and species. It is true that while the great majority of these mutations will be quite useless, and many less good than their parents, yet there will always be a few which are a distinct advance on the ancestral type, and by scientific breeding on Mendelian lines these can be fixed and developed in various recombinations. The great point is the speeding up of these

* Lethal mutations are changes which occur in a gene which, when present in a pure state, prevent fertilization taking place or cause death before birth Other mutations produce unviable plants which linger on for a time, but die before coming to maturity.

progressive mutations by the use of X-rays as compared with their rare occurrence in Nature and in ordinary cultivation and breeding. The evolution of our economic plants can now proceed with greatly increased rapidity, and the new knowledge, properly applied, will have a far-reaching effect on the economics of crop production.

In order to understand the mechanism whereby these results are achieved it is necessary to explain briefly the general principles of the inheritance of characters in plants and animals. All plants and animals have, in each of the minute cells of which they are built up, a certain number of small curved rod-like bodies called chromosomes. The most striking fact about these chromosomes is that their number is usually constant for each cell in the body of any given individual, and, further, it is usually constant for all the individuals of the same species, though different species and genera frequently have different chromosome numbers. For example, all the Asiatic cottons which have been examined have twenty-six chromosomes in their body cells, while all the American cultivated cottons have fifty-two. This difference of chromosome number explains the difficulty in producing hybrids between the two groups, since any progeny will have an unequal number and distribution of chromosomes, giving rise to sterility. Other plants and animals have very variable chromosome numbers from only one or two in some bacteria and fungi up to one or two hundred in some ferns and crustaceans, while man himself has forty-eight chromosomes.

It has been demonstrated experimentally by Morgan, and later by numerous other investigators, that these chromosomes contain large numbers of living particles called *genes*, which are arranged in linear order along the length of the chromosomes. Most important of all is the experimental proof that these genes are the determiners in development of the hereditary characters, and are handed down from one generation to another by means of the chromosomes in the germ cells. During the growth of an individual the cells in its body keep on dividing, and each time they divide each chromosome also divides exactly in half lengthways, so that each new cell contains the same number of chromosomes and genes as its mother cell. In the case of the germ cells, however, the division is different. When their turn comes to divide the chromosomes form up in pairs, showing that there are really two complete sets of chromosomes in each body cell, one derived from the mother parent and one from the father. At the division the chromosomes do not split in two as in the body cells, but one of each pair of chromosomes goes into each of the two new cells, so that the resultant germ cells contain exactly half the

number of chromosomes found in the body cells. Thus the Asiatic cottons have thirteen chromosomes in their male and female germ cells, while the American cottons have twenty-six.*

At fertilization the male and female germ cells meet, each containing one-half the normal number of chromosomes, and their fusion to form the new individual restores the complete number of chromosomes, and the new plant (or animal) starts off with the same number of chromosomes and genes as its parents. If the genes in each of the two parental sets of chromosomes are identical, then the individuals concerned are pure breeding (*homozygous*), but it often happens that they are not identical, various differences having arisen by mutations in some of the genes, or by crossings, so that they are impure (*heterozygous*) for those characters. In such cases the two genes concerned in the two parental chromosomes are alike in kind (*homologous*), but show different reactions, and one is usually *dominant* to the other, which is said to be *recessive*. When they are both present together in the body cells, one dominates the other, which is more or less inactive and recessive, and it is only when bred from that the presence of the recessive gene is discovered by its appearance in a pure state in some of the progeny.†

In cottons the gene representing the dark red or purple spot near the base of the petals, characteristic of many of the South American group and of some of the Asiatic cottons, is dominant to the gene for unspotted petals found in most Upland cottons. In a cross between an individual with a spot and one without, the resulting progeny will all show spots, since this condition is dominant, but on breeding from these their impurity is obvious. When the germ cells are formed on the reduction of the chromosomes, the chromosome with the gene for the spot will go into one cell, while the one with the gene for the unspotted condition will go into the other. By this means half the germ cells will contain the spot character and half will not. When these germ cells meet on fertilization, on the average half those with the spot will meet half those without, giving 50 per cent. individuals showing spotted petals, but carrying the gene for

* In the Asiatic cotton plant at fertilization a male pollen cell carrying a set of thirteen chromosomes fuses with a female egg cell also carrying a set of thirteen chromosomes, thus forming a new embryo cotton plant carrying in each cell two sets of thirteen chromosomes, or twenty-six in all. This number is usually maintained in all the developing body cells of the Asiatic cotton plant until the formation of germ cells with one-half the number of chromosomes completes the cycle.

† A dominant or recessive gene can only be identified by the characteristics (characters) it produces in the plant, and any degree of dominance may appear from full complete dominance with no trace of the recessive character down to one intermediate with half and half of each character.

unspotted petals. The remaining half of the spotted will meet together, giving 25 per cent. pure-breeding spotted individuals, while the remaining unspotted meeting together will give 25 per cent. pure-breeding unspotted. In this way we get the well-known 3 : 1 Mendelian ratio, the 3 representing the dominant spotted individuals and the 1 the pure recessive unspotted. In this way it is evident that the chromosomes provide a perfect mechanism for the passing on of inherited characteristics, and for the segregation of unlike characters.

Normally the genes are remarkably constant and go on from one generation to another absolutely unaltered, each individual being a faithful reproduction of its parents. Occasionally, however, a sudden change occurs in one of the genes, called a mutation, which will cause it to give a different reaction in development. If it is a recessive character its effect will not be apparent until the second generation, when individuals with the new recessive character in a pure state will appear (Fig. 1) and a new variety will be fixed. Until recently it has been a great mystery as to how these sudden changes could arise, but the recent experiments with X-rays have given ample demonstration of one certain and definite way in which they can be caused at a rapid rate.* According to recent calculations

* Breeding experiments of the last twenty years have definitely proved that the genes are living units arranged in linear order along the chromosomes, and the remarkable co-operative experiments of the Russian breeders last year show that in all probability each gene occupies or controls a measurable but apparently varying length of chromosome, so that each gene has normally a definite field or sphere of influence in a chromosome. Further, these Russian experiments show that many recessive mutations of these genes represent the absence or inactivity of the gene in particular parts of its normal field of action, giving rise to the well-known but hitherto inexplicable phenomena of multiple allelomorphs. Whether all recessive mutations are due to this loss of activity in a genic field is not yet known, though it seems probable, since in many cases the normal field of activity of the gene can be restored by the induction of reverse mutations through the application of X-rays. If recessive mutations can be expressed as losses of activity or substance in a genic field, the natural inference is that dominant mutations can be expressed as gains of activity or substance in a genic field, and it is not improbable that mutations dominant to the wild type might equally be represented as extensions of the genic field, possibly through non-disjunction of genes in chromosome divisions.

[An allelomorph is one of a pair of kindred genes which are located opposite to one another in paired (homologous) chromosomes which separate (segregate) from one another in the reduction division, so that one goes into one germ cell (gamete) and the other into a different gamete. This is the essence of Mendelian segregation and heredity. Multiple allelomorphs represent mutations that have taken place in a gene—*e.g.*, if A is the original gene, then mutations B, C, and D occur, giving a set of four multiple allelomorphs of which only a pair can be present in one individual. A is dominant and allelomorphic to B, C, and D, while B is dominant and allelomorphic to C and D, and C is dominant and allelomorphic to D.]

the gene is believed to be structurally a living molecule or chain of molecules. As such it would naturally be susceptible to the bombardment effects of the released electrons of rapid short-wave radiations of the frequency of X-rays. Chance electronic hits might disturb the normal constitution of the complex gene in many and various ways, changing its normal field of activity and giving rise to a new reaction which we call a gene mutation. In this way it is believed that many mutations arise in Nature, where short-waved radiations are frequently found of cosmic, solar, or terrestrial origin. The recent experiments with X-rays seem to be a convincing proof of this, since they automatically produce an enormous increase in the incidence of mutation, the particular mutations caused being identical in nature with those occurring under normal conditions. Mutations may also arise by the direct or indirect influence on the genes and the chromosomes of other agencies, such as other forms of radiation, extremes of temperature, poisons, extremes of nutrition, and attacks by bacteria, fungi, or insects on the germ cells. The available positive evidence, however, suggests that these disturbers of the chromosomes and genes are much slower and more uncertain in their action than the more powerful X-rays, which seldom fail.

In addition to these minute ultra-microscopical changes in the genes, X-rays also have the power to effect larger changes in the chromosomes, which are microscopically visible, and these changes may give rise to more important transmutations, since many mutant genes may be concerned in the process. A frequent occurrence in Nature, and one which often happens in radiated material, is the breaking off of a piece of a chromosome and the attachment of the piece on to another chromosome. In this way a whole block of genes and their resultant characters are transferred from one chromosome to another. It frequently happens that the piece broken off will join on to the end of the other chromosome of the pair to which it belongs. In subsequent generations individuals will arise (Fig. 2) having a complete pair of chromosomes each bearing the extra section. This extra section will have a considerable influence on the characters of the individual, since it is now represented twice in each chromosome, the original part of the chromosome having its own replica of the section, and the resultant characters will appear in a much exaggerated form. This condition of duplication of a chromosome section will also arise by segregation when the broken piece joins any of the other chromosomes. If the contained genes happen to be of some significance—such as the size of fruit, for instance—the new individual may be a vastly improved variety and the new transmuta-

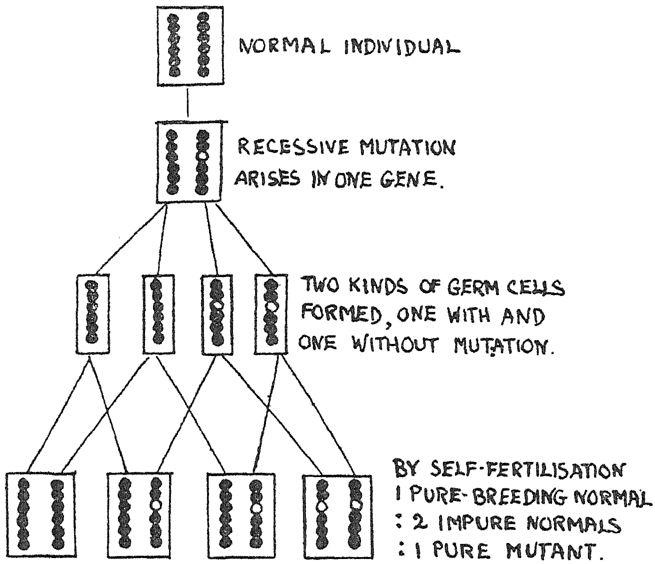

FIG. 1.—DIAGRAM SHOWING INHERITANCE OF A RECESSIVE GENE MUTATION IN ONE CHROMOSOME

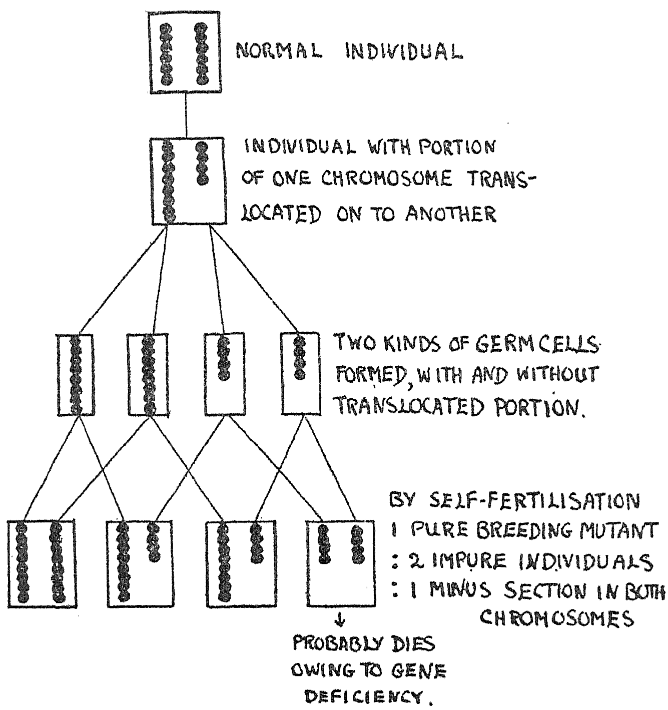

FIG. 2.—DIAGRAM ILLUSTRATING THE INHERITANCE OF A TRANSLOCATION.

tion give rise to a new and valuable stock. The chromosome from which the section was taken is now deficient in those genes and characters, and as a rule when the two germ cells meet containing these chromosomes in a pure state the resulting offspring dies (Fig. 2) owing to its being minus the whole group of characters located in the missing section. Only in the case of the loss of a very small section, or one containing characters unimportant in development, can they produce viable and fertile individuals. Of course, as in the case of gene mutations, for every good transmutation one may get a hundred useless or even lethal characters, but with the possibility of producing them rapidly by artificial means we get an enormous increase in the chance of procuring good varieties.

Another form of transmutation has occurred frequently in animals and plants which may well be the cause of new economic varieties, and that is the presence of an entire chromosome in duplicate. Sometimes during cell divisions both chromosomes of one of the pairs go together into the same cell instead of separating, with the result that one of the cells has one more than the normal number and the other cell one less (Fig. 3). The one with less dies in most cases, since it is short of the whole group of genes contained in the missing chromosome, many of which are necessary to perfect development. The one with the extra chromosome usually carries on to form a good germ cell, and if it takes part in a fertilization an individual arises with an extra chromosome. In subsequent generations individuals arise carrying the extra chromosome in duplicate (Fig. 3), thus forming a race with an extra pair of chromosomes. In cultures it has been difficult in some genera to fix this new type, but it has happened in Nature repeatedly, and an interesting case is that of the apples, which have recently been shown to carry three pairs of extra chromosomes; and it is possible that the evolution of their peculiar pomaceous fruits has been due to this increase of chromosomes. The cultivated cherries have all been found to possess one, two, or three extra chromosomes. Since the effect of an extra chromosome is an increase in size of all parts affected by its contained genes, it is obvious that if the chromosomes bearing the gene for some character of economic importance become duplicated, that character will show a definite increase in size. In the cherries, for instance, it seems, though it is not definitely proved, that the desirable qualities of the fruit in the cultivated forms may be due to the extra chromosomes, varieties having arisen from time to time with the extra chromosomes, and these having been unconsciously selected by breeders for their increase in fruit value. The production of such transmutations by artificial

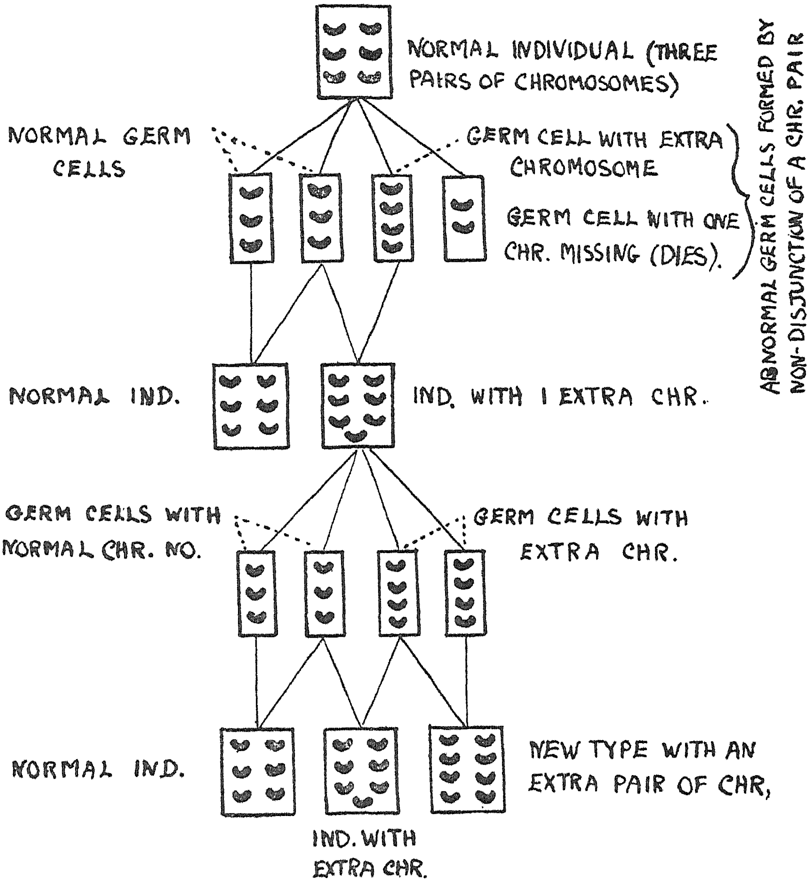

FIG. 3.—DIAGRAM ILLUSTRATING ORIGIN OF A NEW TYPE CARRYING AN EXTRA PAIR OF CHROMOSOMES.

means must in the end provide many new varieties of great economic importance. If a plant has many chromosomes it is, of course, an equal chance as to which chromosome becomes duplicated, but since all have an equal chance the transmutation of the required one must occur sooner or later, and the more variations of this kind that can be produced artificially, the greater the chances of getting those improvements desired as rapidly as possible.

Another effect of X-raying is to reduplicate whole sets of chromosomes (*polyploidy*).* Recent examinations of our garden plants have shown that a large number of our best horticultural varieties have exactly twice as many chromosomes as the parent varieties from which they have been raised (*tetraploid*). For example, in roses, most of the best garden varieties have twice as many chromosomes as the old-fashioned china and tea roses from which they sprang. The same applies to a large number of the greatly improved varieties in other genera—*e.g.*, apples, grapes, mulberries, bananas, sugar-cane, maize, tomatoes, citrus, tulips, hyacinths, narcissus, cannas, dahlias, etc.† The presence of all the chromosomes in duplicate usually produces a general enlargement of all the parts of the plant, since each gene controlling a different character is represented four times instead of twice, as there are now two pairs of each chromosome. Examination of the dividing germ cells in normal plants has shown that occasionally an accident occurs, and the reduction of the paired chromosomes is suspended; and instead of two new cells forming, each with half the number of chromosomes, only one cell forms which contains the entire number. This gives a germ cell with twice the normal number of chromosomes, and if the same thing has occurred in other germ cells an individual is formed with twice the parental number. If it meets a normal germ cell an individual arises with three complete sets of chromosomes (*triploid*) instead of the normal

* Each male and female germ cell (gamete) carries a gametic set of chromosomes. When fertilization takes place the male and female gametic sets of chromosomes unite to form two sets of chromosomes, and the cell so produced is a diploid cell, and plants with such cells are known as *diploids*. If by any means the two sets are reduplicated to four sets of chromosomes the cells and plants become *tetraploid*. Plants carrying one set of chromosomes are known as *haploids*, those with two sets are *diploids*, three sets *triploids*, four sets *tetraploids*, five sets *pentaploids*, six sets *hexaploids*, seven sets *heptaploids*, eight sets *octoploids*, nine sets *enneaploids*, ten sets *decaploids*, and so on. All plants with more than two sets (*diploids*) are called *polyploids*.

† For instance in apples, the varieties Baldwin, Blenheim Orange, Bramley's Seedling, Ribston Pippin, Allington Pippin, Beauty of Bath, Cox's Orange Pippin, Cox's Pomona, Duchess Favourite, Early Victoria, Irish Peach, Keswick Codlin, Lane's Prince Albert, Northern Spy, and Worcester Pearmain are all secondary polyploids with complex sets of chromosomes.

two (*diploid*), and this also will show a general enlargement of the characters, though not so great a one as in those with four sets. Many of our garden and crop plants belong to this category, but since they contain an unpaired set of chromosomes they are largely sterile, and it is only in those genera such as roses, fruit trees, bananas, sugar-cane, and bulbs, which are propagated vegetatively, that they are of any practical importance.

Individuals with the four sets of chromosomes arise more successfully by a suspended division in the body cells. In this case a cell is formed with twice the somatic number,* and its subsequent divisions will give rise to a section of the plant all containing this higher number. If it be a flowering branch thus affected, germ cells will be formed also with twice the normal number; and if it is a self-fertilizing species, a new and vastly improved variety becomes fixed at once.

This reduplication of chromosomes is also caused by X-raying, and often by the effect of external conditions, such as extremes of heat, cold, dryness, etc., at the time of the divisions, or it may be due to a failure in the cell mechanism. Of all the changes which can be brought about by radiation this is perhaps the most useful, since we at once get a strain which is much larger in all its parts, and these reduplicated forms are usually fertile, since their chromosomes are all compatible with one another.

The fact that the American species of cottons have just twice as many chromosomes as the Asiatic species shows that some form of reduplication must have occurred in them. Either they have arisen by the duplication of the chromosomes of the same species, or they may have arisen by another form of duplication which is very frequent in Nature and has been reproduced in cultures with considerable success. In this case two unlike species are hybridized, and since their genes and chromosomes are incompatible with one another they are sterile. Occasionally, however, either a shoot arises with twice the number of chromosomes, or a few rare germ cells are formed by the chromosomes occasionally carrying through a division instead of a reduction, and thus giving rise to germ cells with the entire number of chromosomes in the hybrid. In either case, by the self-fertilization of the reduplicational shoot or by the meeting of two fertile germ cells with the complete sets of parental chromosomes, individuals will arise with twice the number of chromosomes of the

* Somatic chromosomes are the chromosomes in the body cells, which are usually twice as numerous as the gametic chromosomes in the reduced germ cells (gametes).

hybrid and containing two complete sets of chromosomes from each of the original parents. In this way several new species and even new genera have been formed which are completely fertile owing to the presence of each parental chromosome in a paired condition; and they combine the characters of the two species or genera. By further hybridizations it is possible to produce new species which combine three, four, or even more species.

One of the most interesting of these experiments has been the hybridization of the two genera, the radish and the cabbage, which has given rise to a new genus with twice the number of chromosomes of the parents and containing the characters of both.* A new species of tobacco plant has also been raised in this way by the hybridization of two unlike species, and has maintained itself true to type through some ten generations. It is almost certain that the tobacco of commerce arose in this way. These new creations are of course at once fertile owing to the presence (by reduplication) of normally paired sets of chromosomes, and they should prove a valuable source of new varieties of great economic importance, since by this means it is possible to combine the desirable qualities of two species normally sterile when crossed.

In wheats most of the bread wheats have arisen by the natural hybridization of three distinct species of two genera and their subsequent reduplication, and lately further advances have been made by the introduction of a fourth by artificial hybridization followed

* In these experiments Karpechenko crossed the ordinary garden radish (*Raphanus sativus* L.) with various varieties of cabbage (*Brassica oleracea* L.), including common cabbage, savoy cabbage, Brussels sprouts, and kohlrabi. The result in the *first generation* was of no economic interest, since it was purely a botanical experiment, and the peculiar roots of the radish and heads of the cabbage were recessive, the roots were more or less intermediate between the cabbage and the radish, and the typical heads of the cabbage were completely recessive. The white flowers of the radish were dominant to the yellow flowers of the cabbage. The hybrids were all sterile except when gametes arose containing the entire number of chromosomes, some of which produced plants in the second generation with twice the number of chromosomes in the hybrid. These were fertile, and a true-breeding new genus was fixed which might be called *Raphano-brassica*, with intermediate botanical characters generically distinct from both *Raphanus* and *Brassica*. In order to get economic results it will be necessary to grow these hybrids in a more temperate climate, where the plants with radish tendencies are not killed off, and further it will be necessary to raise the third generation in large numbers of controlled genetical matings before results of economic value can be expected. Even then it is doubtful if the combination of cabbage heads and radish roots would be an economic proposition, since in many ways such a combination would be to a large extent mutually exclusive. The chief interest is that a new genus has been raised and made fertile and permanent by hybridization and the reduplication of the chromosomes of the hybrid.

by chromosome duplication. X-ray treatment has not been used in these cases, or at all events no results have been published, but it seems feasible that if they produce reduplications in the normal individuals, they should also do it in the hybrids, and by this means many hitherto obstinately sterile hybrids might be induced to duplicate and form the desired fertile new species.

Space is too limited to allow of more than this brief summary of the different ways in which new varieties may arise, but it will be seen that there are many possible courses. The greatest changes are effected by the alterations in the chromosomes, especially those in which whole sets are involved, and so far as the experiments have shown, plants are extremely susceptible to these changes under the influence of X-rays. Although the changes in the chromosomes produce more obvious effect, since they involve a change in a large number of genes, yet no really new characters are evolved in this way, only new recombinations of old characters. The new creative changes occur originally by gene mutations, though the chromosome transmutations often open the way for these by the increased material they provide in which gene mutations may occur.

Goodspeed was one of the earliest and most successful workers in the X-raying of plants. He has done some interesting work with cotton, X-raying the pollen of a highly selected strain which was as true breeding as possible. A considerable amount of sterility resulted from the treatment, but twenty-one plants were raised. Many of these varied considerably from the untreated controls, three showed a marked increase of the size of the seeds, but most important of all were two plants which produced "naked seeds," the cotton fibres, which were attached to the seeds in the parent and which must be pulled away in ginning, being entirely free at maturity in these. Three other plants showed this character to a marked extent, the normal controls not showing it at all. From this work Goodspeed concludes that alterations in the genes and chromosomes may easily be produced in cotton by radiations, giving rise ultimately to new and improved economic varieties.

His most extensive work, however, has been with tobaccos. Treating various plants with X-rays, he found that their progeny differed tremendously from those of untreated plants. Many different types of mutations arose, some due to changes in the genes, others to chromosome non-disjunction giving rise to extra chromosomes, and others to fragmented chromosomes. Two stable derivatives of *Nicotiana tabacum* were raised, resulting from induced reorganization of chromosomal material, and Goodspeed considers from his results

that the application of the rays to economic plants is of great practical importance.

In wheats Delaunay produced various mutations, one of which showed an advance on the type, inasmuch as it was very strong growing, dark green, and four days earlier in ripening. Other investigators with other plants—*e.g.*, oats, barley, and maize—have fully confirmed these results, showing the incidence of mutation to be enormously increased by X-raying.

The all-important point is that the means of speeding up these new creations is now in the hands of man. Now that he is able to produce at will unlimited numbers of mutations and transmutations from which to choose those needful for his purpose, the work of breeding should go ahead with great rapidity, and in the future we may confidently look forward to hitherto undreamed-of improvements not only in cotton breeding, but in all our cultivated plants.

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A HANDY FORM OF NOMOGRAPH FOR CALCULATING THE GINNING OUT-TURN OF SINGLE PLANTS

BY

TREVOR TROUGHT,

Cotton Research Botanist, Lyallpur, Punjab.

THE diagrams and photos which accompany this note are almost self-explanatory. The Nomograph is pasted on a revolving cylinder. The pointers slide on the brass scale which is fixed parallel with the axis of the cylinder. The upper pointer is set to the weight of seed-cotton, and the lower pointer to the weight of lint. The cylinder is revolved till the tip of the upper pointer coincides with the diagonal line representing 100 per cent. The percentage of lint is given direct by the Nomograph reading at the lower pointer.

The accuracy is to within ½ per cent., which is near enough for work with single plants.

Three scales are marked on the brass bar. Then, whatever the weight of seed-cotton used, the upper pointer can be kept towards the top of the scale so that the readings of the lower pointer always fall in the wider part of the Nomograph.

This instrument has been in use in the Cotton Research Laboratory, Lyallpur, for two or three years and has proved entirely satisfactory. It can be used by any assistant, and after the weights of seed-cotton and lint have been tabulated, the G.O.T.s can be read off at the rate of two or three a minute.

The dimensions of the box are 28·5 by 18 by 11·5 cms. This has been found to be a convenient size, but the actual size within limits is not particularly important. The brass scale was machine-ruled, and again the actual size of the divisions does not matter. In the instrument figured, 10 units on the right-hand scale measure 6 cms. It will be noticed that the middle and left-hand scales have respectively twice and four times the number of divisions of the right-hand scale. These factors were selected arbitrarily as giving a range which would cover normal requirements.

It does not matter what unit of weight is used—grams, ounces,

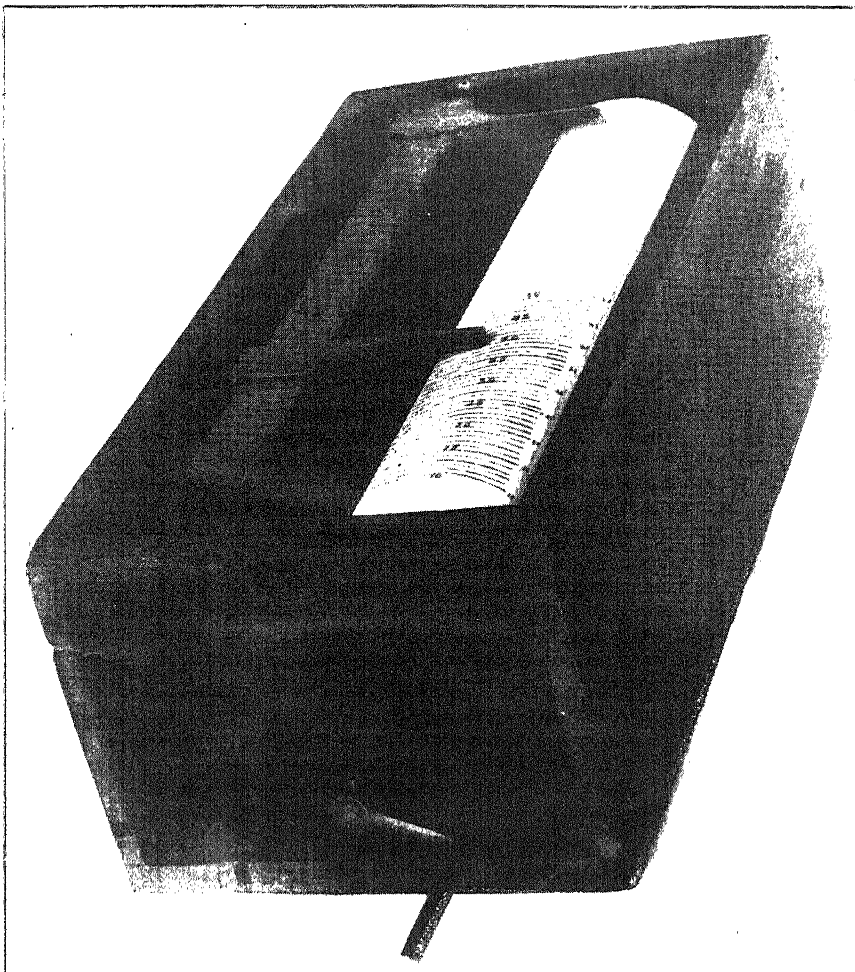

Fig. 1.—Side View.

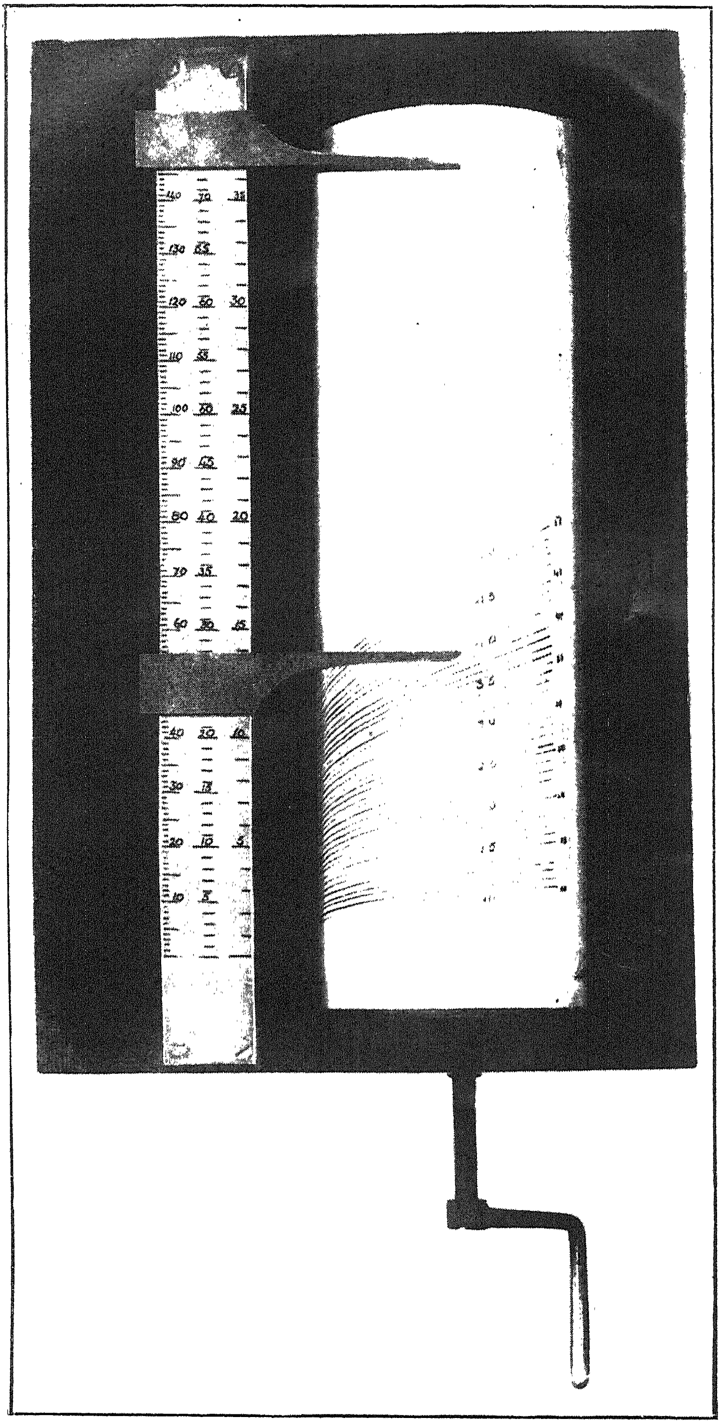

Fig. 2.—Top View.

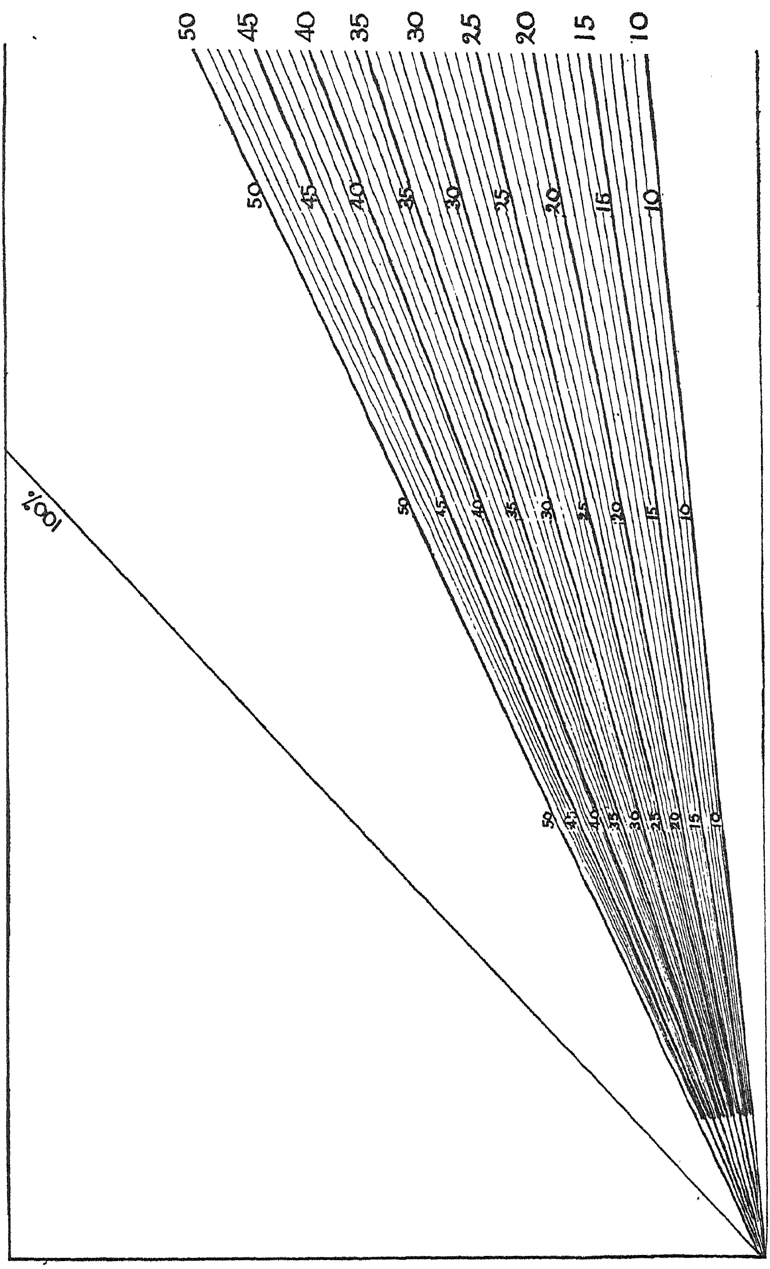

FIG. 3.—THE CHART.

pounds, etc. If the weight is under 35 units, in this instrument the right-hand scale would be used; if it is between 35 and 75 units, the middle scale would be used; between 75 and 150, the left-hand scale. Above 150 units, it would be necessary to divide the weights by some simple factor such as 10 in order to bring the weight within the range of one of the scales.

The diameter of the roller is approximately 8 cms. This permits of a base line of 25 cms. on the chart. The right-hand vertical is also 25 cms., so that the line joining the origin with the tip of the vertical makes an angle of 45° with the horizontal axis. It is important in pasting on the chart to the roller that the base line and the zero of the scales coincide. The vertical line is divided into 100 equal parts, and these points are joined to the origin, giving steps of 1 per cent. The lines above 50 per cent. are not ruled in, as the G.O.T.s are not likely to be above that figure. For greater ease in reading off the percentages, every 5 per cent. line can be ruled in red ink.

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EXTERMINATION OF LOCUSTS BY AEROPLANE

BY

ROGER THOMAS, B.Sc.

During a tour through the Cotton Belt of the U.S.A. in 1926-27 the writer was privileged in having access to certain papers of the U.S.A. Army Air Service dealing with the extermination of locusts by aeroplane in the Philippine Islands. The work done in applying calcium arsenate with the aid of an aeroplane was largely experimental, but the success with which it was attended may prove to be of interest to all those concerned with locust control in the tropics.

The work was undertaken in October, 1923, near Mindoro, Philippine Islands, about 190 miles south of Manilla. Twenty-four sectors were infested with the locust, in all stages from unhatched eggs to locusts in flight. Six " fields " were established, covering an area of about 100 square miles, and the entire area was photographed. Camps were established at each field and personnel detailed for pest control in conjunction with the use of aeroplanes. Food for personnel and poison for locusts were conveyed to each camp by plane. Every two days the plane patrolled the zone scouting for infested areas (weather conditions permitting).

The locusts breed in the submontane tract and move down to the lowlands, destroying the crops in their path. The camps were located at the breeding places, and the landing fields were established in a semicircle amongst the hills adjacent to San José. Transportation of camp kit was partly by plane and partly by road.

The fact that locusts generally lay their eggs in open spaces and not in timbered country makes them vulnerable to attack by plane. In those localities where eggs were laid between clumps of tall grass it was almost impossible to control the " hoppers " effectively by the customary methods of poisoning.

When the infested area has been located, a scout is detailed to determine the stage of development of the locusts. The boundaries of the area are marked in such a way as to be discernible from a low-flying plane. Marking is done just before sundown, when the locust settles for the night. The dusting plane arrives immediately after, and, flying parallel with the *long* side of the area to be dusted, releases

a trial puff of powder; the plane then rises and the pilot observes the behaviour of the dust cloud. This determines the following salient points, which must be known to the pilot before he starts in earnest:

(*a*) Wind direction;
(*b*) Proper altitude at which to fly;
(*c*) Distance powder cloud will travel before settling;
(*d*) Whether the cloud will drift over the entire area;
(*e*) The optimum direction of flight relative to the area to be covered and to wind direction.

These facts determined, the pilot decides on his line of flight and releases dust in a straight line. If necessary, he repeats the operation to windward in parallel lines of flight until the whole of the infested area is covered with the dust cloud. A small zone on the line of advance of the swarm must also be dusted, so as to poison such of the locusts as would possibly revive by the next morning. This zone must be indicated on the ground by an arrow for the pilot's guidance. Unless this is done, the casualties may not exceed 50 per cent., whereas by spraying a zone in the path of travel 100 per cent. casualties can be effected.

Owing to the locusts being on the move in the mornings, dusting was found to be more effective in the evenings. Practically still air is necessary for optimum results. The most effective altitude for a plane when releasing dust was found to be 10 to 15 ft.

It was only after trial with many types of mechanical "hoppers" for releasing dust that a desirable one was obtained, working on the Venturi principle. Since this work was undertaken much progress has been made in designing suitable "hoppers" for dusting cotton fields in the U.S.A. for purposes of controlling the boll weevil. Details of design of the most up-to-date "hoppers," and of supplies of calcium arsenate powder suitable for this purpose, could probably be obtained from the U.S.A. Department of Agriculture, Washington, D.C.

A desirable "hopper" should combine the following features:

(*a*) Positive in operation;
(*b*) Adaptable to various types of planes;
(*c*) Air tight;
(*d*) Lightness in design;
(*e*) Simple in construction and as foolproof as possible;
(*f*) Must not require the pilot to move his hands from the controls while flying;

(*g*) Must evade risks of jamming and banking of powder;
(*h*) Must release the powder into the slip stream and not foul the fuselage.

In this experiment other methods of destroying the pest were also tried for purposes of comparison as to their efficacy. These methods included:

(*a*) Driving the locust hoppers into prepared trenches;
(*b*) Using hand machines for dusting calcium arsenate;
(*c*) Liquid contact poisons from hand-spraying machines;
(*d*) Burning with dried grass.

None of these alternative methods proved to be nearly as efficacious as dusting calcium arsenate from a plane. It was demonstrated to the sceptical local inhabitants beforehand that calcium arsenate dusting was innocuous to the crops as well as to man and beast.

The proved facts in this experiment may be summarized as follows:

(1) That the aeroplane can, under certain environmental conditions, be used against the locust in the hopper stage so effectively as to annihilate swarms.
(2) That a slow plane will prove to be most effective, and more especially in broken terrain or undulating country.
(3) That the aeroplane is invaluable for the rapid transport of men, food, supplies and insecticides to isolated areas.
(4) That the aeroplane can be very effective in locating swarms of locusts.
(5) That the majority of breeding places can, under certain conditions, be located from the air.
(6) That the aeroplane can apply calcium arsenate dust insecticide more thoroughly and economically than can be done by other means.
(7) That a pilot engaged on this work should first make himself acquainted with the habits of the locust, its life history, breeding places, etc.

Received February, 1931.

COTTON STATISTICS

WORLD'S CROPS—AMERICAN AND EGYPTIAN

BY

JOHN A. TODD, M.A., B.L.

THIS year we have entirely recast the table of the world's crops so as to include more detail (which has involved dropping out the years before 1914), and the whole table has been rearranged in rough geographical order. At the same time, in view of the increasing importance of the relative supplies and consumption of Outside Growths as compared with American, we have added to this table a separate total of Outside Growths with a percentage figure. We have also recast the diagram of the world's crops in order to bring out more clearly the relative movement of American and Outside Growths.

Taking first the world's total cotton supplies, the final figures for 1929 were rather less than our preliminary estimates and were little better than the last pre-war year. Thus 1925 and 1926 still stand out as the record years. The preliminary estimates for 1930, which of course at this stage contain a considerable amount of guesswork, show a definite reduction on the previous season which would have been much greater but for the large increase of the Russian crop.

The relative figures of American and Outside Growths do not bear out the general impression that Outside Growths are increasing rapidly. As a matter of fact the total has changed very little in the last three years, and is well below the record of 1925. The explanation of this, however, lies in the marked failure of the Indian crop to maintain its record of 1925. To bring this out we have included the Indian crop in the diagram in order to show the peculiar relation which exists between the American crop and the world's total on the one hand, and the Indian crop and the total Outside Growths on the other. It will be seen that just as the American crop still on the whole dominates the world's supplies, so the Indian crop still dominates the total of Outside Growths, but in each case the domination is being increasingly threatened by the increase of new crops, of which the Russian crop is the outstanding example. As a matter of fact the Russian crop is now the third largest in the world, having over-

taken both Egypt and China this year; and as the Soviet are planning for a further increase of 40 per cent. in 1931, Russia is likely still further to improve her relative position. As the quality of the Russian crop is very well spoken of, being now, it is said, entirely of good American staple, this is becoming a very important factor in the world's cotton supplies.

AMERICAN CROP.—The outstanding feature of the crop history of the year has, of course, been the great drought which this year extended from the West well into the Mississippi Valley. The result has been to illustrate again the extremely fine edge upon which the fate of the American crop is balanced, between the weevil and the weather. Drought is the only thing that will seriously handicap the weevil, and if sufficiently severe to do so it is very liable to injure the crop. It looks as if 1925 and 1926 might stand out in history as the two years when the crop just managed to scrape through between Scylla and Charybdis.

Another indication of the season's weather is that the percentage of untenderable cotton this year is much smaller than last year. It is rather remarkable that in a drought year there has been apparently a much smaller proportion of short staple cotton. On the other hand, reports of the quality of the crop this season, especially Texas, are quite as bad as last year.

Under these conditions the Crop Reporting Board scored a very definite success, for when in August the crop looked like being almost ruined, they, working on their new "Boll-count" system, which is now apparently the major factor in the crop reports, refused to be scared, and put the crop a good deal higher than the general opinion, which was indicated by the extremely low condition figure put forward by the Crop Reporters. The result is that the extreme range of the estimates so far is only 243,000 bales, which is certainly a record.

EGYPTIAN CROP.—The total area this year was a new record, but although what may be called the Sakel varieties (*i.e.*, including Maarad, etc.) increased their total a little, the percentage showed a further reduction. The tendency towards a larger proportion of Uppers varieties has now become the official policy of the Government for 1931. The 1930 crop is likely to prove a serious disappointment, the average yield, according to the Alexandria General Produce Association's November estimate, being the lowest since 1923, and other more recent estimates are still lower.

The reports of the Sudan crop this year are also very disappointing, the latest estimate being even less than last year.

TABLE I.—WORLD'S COTTON

(BALES OF 500 LBS.

	1914–15.	1915–16.	1916–17.	1917–18.	1918–19.	1919–20.	1920–21.
America.							
U.S.A. Lint	16,135	11,192	11,450	11,302	12,040	11,421	13,440
Linters	857	931	1,331	1,126	930	608	440
Total	16,992	12,123	12,781	12,428	12,970	12,029	13,880
Mexico	125	109	111	95	236	200	194
Brazil	456	312	310	374	374	463	430
Peru	118	105	119	120	132	159	166
Argentine	3	4	3	12	15	15	28
Others	8	11	12	12	11	9	11
Asia.							
India*	5,209	3,738	4,489	4,000	3,972	5,796	3,600
China	2,333	1,882	1,534	2,046	2,903	2,470	1,829
Japan and Korea ..	37	45	37	60	71	92	103
East Indies, etc. ..	23	23	37	16	25	20	31
Russia	1,070	1,303	1,142	618	288	210	73
Persia	139	133	95	82	85	150	102
Iraq, Ceylon, etc. ..	†	†	†	†	†	†	†
Asia Minor and Europe	140	112	117	104	95	114	106
Africa.							
Egypt	1,298	961	1,022	1,262	964	1,114	1,206
Sudan	19	13	18	9	13	19	24
East Africa (British) ..	34	27	26	27	35	43	75
South Africa (British) ..	1	1	1	1	2	2	2
West Africa (British) ..	12	6	16	10	14	13	24
Non-British	4	3	7	8	8	11	13
West Indies (British) ..	5	4	3	3	4	5	5
West Indies (Others) ..	11	7	7	9	8	17	11
Australia, etc.	†	†	†	†	†	†	1
World's Total ..	28,037	20,922	21,887	21,296	22,225	22,951	21,914
Outside Growths ..	11,045	8,799	9,106	8,868	9,255	10,922	8,034
Per cent. on Total ..	39·4	42·1	41·6	41·6	41·6	47·8	36·7

* Government Estimate, 400 lb. bales. † Less than 500 bales.

CROPS, 1914–1930.

APPROXIMATELY, 000'S OMITTED.)

1921–22.	1922–23.	1923–24.	1924–25.	1925–26.	1926–27.	1927–28.	1928–29.	1929–30.	1930–31.
7,954	9,762	10,140	13,628	16,104	17,977	12,956	14,478	14,825	14,243
397	608	668	897	1,115	1,158	1,016	1,282	1,241	1,150
8,351	10,370	10,808	14,525	17,219	19,135	13,972	15,760	16,066	15,393
145	191	160	240	199	351	175	272	240	169
491	538	561	649	589	490	480	511	547	411
181	187	199	198	186	243	234	213	213	*200*
18	29	62	75	136	65	103	129	150	*200*
45	26	67	84	70	74	58	78	63	*61*
4,485	5,073	5,161	6,088	6,215	5,024	5,963	5,811	5,260	*5,000*
1,488	2,249	1,931	2,104	2,074	1,707	1,821	1,790	1,884	1,750
89	106	113	122	122	141	131	148	136	152
27	26	21	20	19	13	14	14	13	*15*
69	54	215	443	741	785	993	1,136	1,377	1,950
95	63	79	58	82	83	73	90	100	*100*
†	†	1	2	3	3	2	6	5	4
45	39	78	110	162	134	214	131	162	*171*
972	1,243	1,306	1,455	1,593	1,727	1,219	1,602	1,697	*1,600*
19	23	38	36	97	118	101	129	126	120
49	80	119	180	168	128	128	196	121	*160*
2	5	9	18	22	9	9	8	15	*15*
12	13	21	32	39	22	17	26	30	*30*
16	26	39	65	74	80	86	109	103	*100*
4	3	4	3	3	5	5	3	4	4
22	17	17	19	25	24	22	23	26	*25*
3	7	10	12	6	5	8	5	7	8
16,628	20,368	21,019	26,548	29,844	30,366	25,828	28,188	28,344	27,638
8,277	9,998	10,211	12,023	12,625	11,231	11,856	12,428	12,278	12,245
49·8	49·1	48·6	45·3	42·3	37·0	45·9	44·1	43·3	44·3

Estimates in *italics*.

TABLE II.—AMERICAN ACREAGE, CROP, YIELD PER ACRE, AND PRICE, 1911–30.

Season.	*Acreage Harvested* (000's).	*Crop (Running Bales,* 000's). *Cotton.*	*Linters.*	*Total.*	*Average Yield (Lbs. per Acre) (Ex Linters).*	*Average Price Middling (Pence per Lb.).*
1911–12	36,045	15,553	556	16,109	207·7	6·09
1912–13	34,283	13,489	602	14,091	190·9	6·76
1913–14	37,089	13,983	631	14,614	182·0	7·26
1914–15	36,832	15,906	832	16,738	209·2	5·22
1915–16	31,412	11,068	945	12,013	170·3	7·51
1916–17	34,985	11,364	1,300	12,664	156·6	12·33
1917–18	33,841	11,248	1,096	12,345	159·7	21·68
1918–19	36,008	11,906	910	12,817	159·6	19·73
1919–20	33,566	11,326	595	11,921	161·5	25·31
1920–21	35,878	13,271	429	13,700	178·4	11·89
1921–22	30,509	7,978	382	8,360	124·5	11·37
1922–23	33,036	9,729	591	10,320	141·5	14·92
1923–24	37,123	10,171	640	10,811	130·6	17·66
1924–25	41,360	13,639	858	14,497	157·4	13·76
1925–26	46,053	16,123	1,044	17,167	167·2	10·77
1926–27	47,087	17,755	1,042	18,977	182·6	8·15
1927–28	40,138	12,783	875	13,658	154·5	11·17
1928–29	45,341	14,297	1,086	15,383	152·9	10·52
1929–30	45,793	14,548	1,037	15,585	155·0	9·09
1930–31	45,218	*14,000**	*1,000*	*15,000*	150·8	—

* December estimate, based on 1929 bale weights.

TABLE III.—EGYPTIAN AREA, CROP, YIELD, AND PRICE, 1914–30.

Season.	*Area. Feddans.* 000's.	*Crop. Kantars.* 000's.	*Average Yield per Feddan (Kantars).*	*Season's Average Prices.* *F. G. F. Brown. Pence per Lb.*	*Premium over American Middling (per Cent.).*	*Sudan Crop. Kantars.* 000's.
1914–15	1,755	6,490	3·70	7·34	40	95
1915–16	1,186	4,806	4·06	10·42	39	65
1916–17	1,656	5,111	3·10	21·56	75	92
				Sakel.		
1917–18	1,677	6,308	3·75	30·97	43	45
1918–19	1,316	4,821	3·66	27·85	41	64
1919–20	1,574	5,572	3·54	60·34	139	93
1920–21	1,828	6,030	3·30	30·24	154	122
1921–22	1,292	4,858	3·76	19·75	74	96
1922–23	1,801	6,213	3·45	17·29	16	113
1923–24	1,715	6,531	3·81	21·55	22	191
1924–25	1,788	7,274	4·07	29·82	117	180
1925–26	1,924	7,965	4·14	20·05	86	485
1926–27	1,786	8,635*	4·84	15·39	89	592
1927–28	1,516	6,097	4·02	19·39	74	534
1928–29	1,738	8,012	4·61	18·14	72	684
1929–30	1,841	8,485	4·61	14·52	60	672
1930–31	2,082	*8,185†*	*3·93*	—	—	*640*

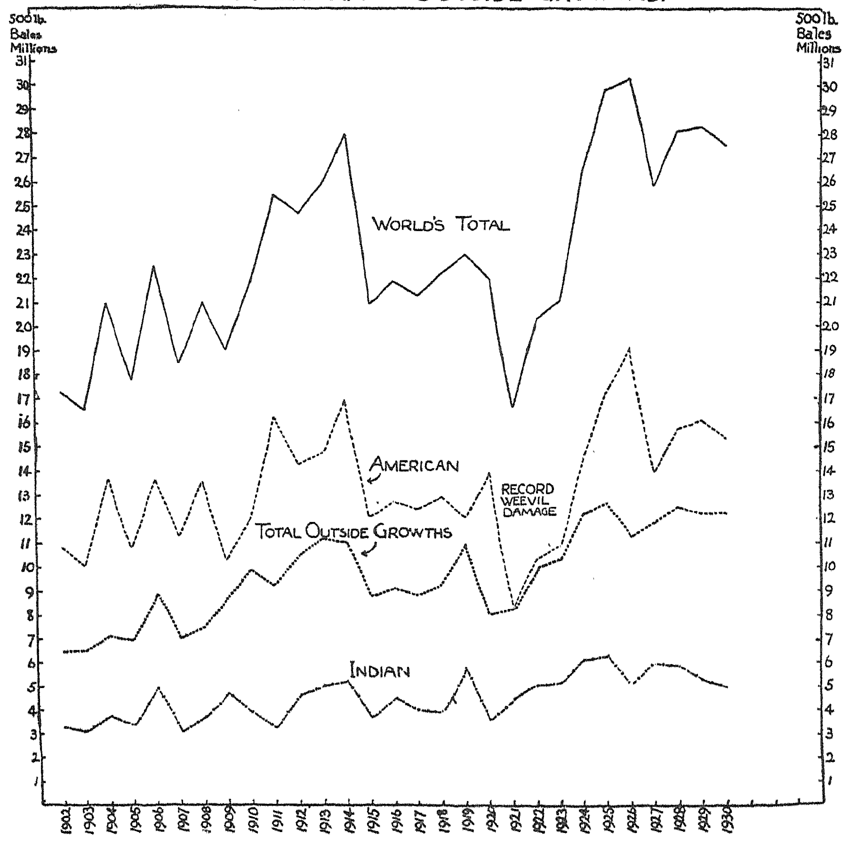
* The Government's final estimate was 7,652,190 kantars, the difference being the carry-over up-country.

† A. G. P. A. November estimate.

TABLE IV.—EGYPTIAN CROP: AREA BY VARIETIES.

	1914.	1919.	1920.	1921.	1922.	1923.	1924.	1925.	1926.	1927.	1928.	1929.	1930.
Sakel	394,403	1,146,443	1,270,481	995,479	1,358,162	1,255,000	872,624	1,128,946	981,783	795,740	799,523	847,950	837,344
Per cent. ..	22·4	72·9	69·5	77·0	75·4	73·2	48·8	58·7	55·0	52·5	46·0	46·0	40·2
Jannovitch ..	127,531	97	2,087	300	225	—	—	—	—	Nahda	25,883	44,331	25,108
Per cent. ..	7·3	—	—	—	—						1·5	2·4	1·2
Abbassi ..	12,281	3,718	12,558	1,267	2,274	—	—	—	—	Maarad	—	21,548	66,103
Per cent. ..	0·7	0·2	0·7	0·1	0·2							1·2	3·2
Nubari	261,775	23,611	37,320	8,645	11,090	10,660	—	—	—	Fouadi	—	13,522	32,987
Per cent. ..	14·9	1·5	2·0	0·7	0·6	0·6						0·7	1·6
Afifi	467,350	35,145	44,068	6,771	8,202	6,050	22,271	8,384	4,234	Cazouli 4,261	—	11,397	9,491
Per cent. ..	26·6	2·2	2·4	0·5	0·5	0·3	1·3	0·4	0·2	0·3	—	0·6	0·5
Assili	134,104	21,003	30,051	5,839	7,863	7,820							
Per cent. ..	7·7	1·3	1·6	0·5	0·4	0·5							
Pilion				319	20		49,960	72,799	102,394	74,451	97,218	87,537	124,254
Per cent. ..				—	—		2·8	3·7	5·7	4·9	5·6	4·8	6·0
Ashmouni ..	353,882	334,160	283,906	170,514	276,193	310,150	796,362	270,842	667,474	599,149	768,411	419,098	936,134
Per cent. ..	20·2	21·3	15·5	13·2	15·3	18·1	44·5	14·1	37·4	39·5	44·2	22·8	44·9
Zagora			97,612	92,536	126,541	102,390		388,578				384,971	
Per cent. ..			5·3	7·2	7·1	6·0		20·2				20·9	
Others	3,944	9,485	49,787	10,208	10,273	23,080	46,626	54,833	29,817	42,598	47,437	11,124	50,999
Per cent. ..	0·2	0·6	2·7	0·8	0·5	1·3	2·6	2·8	1·7	2·8	2·7	0·6	2·4
Totals	1,755,270	1,573,662	1,827,870	1,291,878	1,800,843	1,715,150	1,787,843	1,924,382	1,785,702	1,516,199	1,738,472	1,841,478	2,082,420
Lower Egypt	1,373,243	1,219,303	1,378,503	1,012,349	1,378,095	1,289,520	1,264,450	1,363,318	1,248,381	1,039,236	1,143,400	1,218,152	—
Per cent. ..	78·2	77·5	75·4	78·4	76·5	75·2	70·7	70·8	69·9	68·5	65·8	66·2	—
Upper Egypt	382,027	354,359	449,367	279,529	422,748	425,630	523,393	561,064	537,321	476,963	595,072	623,326	—
Per cent. ..	21·8	22·5	24·6	21·6	23·5	24·8	29·3	29·2	30·1	31·5	34·2	33·8	—

WORLD'S COTTON CROPS.
AMERICAN v. OUTSIDE GROWTHS.



NOTES ON CURRENT LITERATURE

COTTON IN INDIA.

171. The following reports have recently been received:

Report of the Ahmedabad Millowners' Association, 1929-30.

Agra and Oudh: Rpt. of Agr. Stats. of Western Circle, 1930.

Cawnpore: Rpt. of Agr. Stats. of Central Circle, 1929-30.

Madras: Operations of Dpt. of Agr., 1929-30.

Punjab: Rpt. of Operations of Dpt. of Agr., 1929, Pt. II., Vol. II.

172. Report on the Work of the Indian Trade Commissioner during 1928-29 and 1929-30. By H. A. F. Lindsay. This interesting report deals, among other matters, with Modern Trade Tendencies, Markets for Indian Timbers and Indian Minerals; Agricultural Products—foodstuffs and industrial materials; Trade Publicity—general policy, exhibitions and fairs, exhibits and enquiries.

It is stated that the imports of Indian cotton are increasing in nearly all countries, and in the United Kingdom have trebled. With the improvement in the varieties of Indian cotton both as regards quality and staple, and with the extension in the areas under cultivation likely to follow the completion of the Sukkur Barrage, prospects for further developing the sales of these cottons in Europe are undoubtedly bright. One important warning is, however, necessary. The practice of mixing the better varieties with inferior strains—*e.g.*, Punjab-American with Desi—tends to lower the good reputation of Indian cottons abroad, and should at all costs be avoided.

173. Indian Central Cotton Committee. At the twenty-second meeting held in December last, the President referred to the valuable work done by Dr. A. J. Turner, late Director of the Technological Research Laboratory, Matunga, who has left India to take up an appointment in England, and also to the impending departure from Indore of Mr. A. Howard, who has held the important post of Director of the Institute of Plant Industry since its inception.

The following matters were also dealt with by the President in his speech: The decision of the Liverpool Cotton Association to fix standards for the best of the Indian Cottons; the working of the Cotton Transport Act and the Cotton Ginning and Pressing Factories Act; the publication of cotton crop forecasts in Bombay and at other important centres up-country simultaneously with their release in Calcutta; the sanctioning of certain small grants to three local Governments for investigations into the cost of ginning and pressing in factories in their respective Provinces; the need for stringent measures in Madras to prevent the spread of the inferior Pulichai variety of cotton in the Tinnevelly area.

174. Indian Central Cotton Committee. (*Ann. Rpt.* to August 31, 1930.) An interesting account of the work of the year in connection with the Cotton Transport and Cotton Ginning and Pressing Factories Acts, malpractices, finance of cotton crop and primary cotton marketing, cotton markets, marketing of improved varieties of cotton, cotton marketing in Karachi, means to prevent the introduction of foreign cotton pests, cotton statistics. Under the heading of Research the following are discussed: The work of the Technological Laboratory and of the Indore Institute of Plant Industry, grants-in-aid, new schemes sanctioned, seed extension schemes, research students.

The Annual Report of the Director, Technological Laboratory, 1929-30,

which is also included, gives the reasons which led to the establishment of the laboratory, and describes the work carried out during the year at the Spinning and Research sections.

175. Cotton Growing in India in Relation to Climate. By T. Trought and M. Afzal. (*Mem. of the Dept. of Agric. in India*, vol. xvii., No. 5, 1930.) An attempt has been made to compare the climatic conditions prevailing in typical cotton-growing localities in India. The different factors have been treated separately, but it is recognized that the effect of each depends on the other. Information of this sort will, it is hoped, contribute to a proper understanding of the various ecological problems of the cotton plant and its pests. The greatest similarity of conditions at the various places is during the middle of the picking season, and not about a month or so before picking, as found by Williams in Egypt and the Sudan. Rainfall is low in the later half of the growing and throughout the picking seasons. Relative humidity varies enormously at different places during the course of the year.

176. Indian Staple Cottons: Improvement and Deterioration. Indian Central Cotton Committee. (*Rpt. of the Millowners Asscn.*, Bombay, 1929, pp. 22 and 147. Abstr. from *Summ. of Curr. Lit.*, x., 24, 1931, p. 667.) The following notes are the result of a census of trade opinion as to the improvement or deterioration of Indian staple cottons during the past five years: *Coompta Dharwar:* Pure Coomptas have not deteriorated; the strength of staple has been maintained, and the cotton can be used for the same counts of yarn as before, but it has become much more difficult to obtain unmixed Coompta cotton in Bombay. Much of the genuine Coompta cotton, owing to admixture with Uplands, is much cleaner and whiter than before. *Westerns and Northerns :* Progressive deterioration has been noticed in both the strength and length of staple, and they are more fluffy than before. Deterioration is said to be due to lack of classification of kapas before ginning, the mixture of short-staple seed in sowing, mixing of waste when ginning, and watering when pressing. *Cambodia Karunganni :* A little weakness in strength of staple was noticed. It showed a slight unevenness and was a little more neppy. Quality has deteriorated. Pure Cambodias have lost their silky appearance and have deteriorated in staple. *Surats :* This variety appears to have shown a slight improvement during the last five years, but in certain tracts, owing to excessive rain and frost, the last year's crop was damaged to some extent. *Dhollera, Broach :* The strength of staple is weaker and the length shorter. It has lost its spinning value owing to the presence of black leaf and admixture with inferior types of Gujerat seeds. Broach cotton has also depreciated in quality during the last four years. *Moglai* (*Latur, Nanded*) *:* The cotton arriving in Bombay is poor in staple compared with what it was five years ago, but when it is used in up-country mills it appears to be fully equal in staple to the cotton five years back. Nanded cotton has lost its spinning value, having depreciated in many respects. Parbhani cotton does not give as good results as it gave some years ago; the main defects seem to be crushed seeds, leaf, stain, etc. Latur and Nanded cottons are not capable of spinning 20's yarn. Moglai cotton might almost be said to have lost its value as a long-staple cotton. *Punjab-American :* Deterioration in staple is marked. The cotton has become more leafy, irregular, and much weaker in staple length and strength. Mixing of this type of cotton with Deshi is adopted to such an extent that it is almost impossible to obtain it pure. Indiscriminate mixing with Deshi is the cause of the gradual depreciation. It is suitable for spinning 16's only. It was also pointed out with reference to the Westerns and Northerns, Cambodia, Karunganni, and Moglai (Nanded, Latur, etc.) varieties of cotton, that it would be

advisable for the Indian Central Cotton Committee to ascertain if it is not a fact that there is no deterioration in the pure varieties of these cottons.

177. TECHNOLOGICAL REPORTS ON STANDARD INDIAN COTTONS. By A. J. Turner and N. Ahmad. (*Indian Cent. Cot. Comm. Tech. Circs. Nos.* 34, 35 and 37.) The circulars contain the grader's report and spinning test results for Westerns, Gadag-Upland, Tinnevelly, Kampala, Busoga, and Jinja cottons for the 1929-30 season, and Bengals (Kasgunj) cotton for the 1930-31 season.

178. TECHNOLOGICAL REPORTS ON STANDARD INDIAN COTTONS. By A. J. Turner. A copy has been received from the Indian Central Cotton Committee of a report on Verum 262 (Akolo), 1930-31. The particulars include Agricultural Details, Grader's Report, Fibre Particulars, Spinning Tests, Remarks and Conclusions. This cotton is stated to have given its worst results in 1930-31, and is described as suitable for 18½'s warp.

179. NOTES ON INDIAN COTTONS. By A. J. Turner. (*Int. Cot. Bull.*, ix., 33, 1930, p. 96.) A valuable article on Indian cottons, including a table showing the distribution of the crop according to the trade descriptions, the blow-room losses sustained by the different growths, and the types of yarn for which they are severally suitable.

180. LIMIT SPINNING TESTS ON CAMBODIA AND MOLLISONI COTTONS. By R. P. Richardson and A. J. Turner. (*Tech. Bull.*, Ser. A, No. 17. Indian Central Cotton Committee, 1930.) Tests have been carried out to explore the possibilities of spinning Cambodia Co. 1 (295) (1927-28) and Mollisoni (1925-26) from carded single rovings at much higher counts than they are usually spun at the Technological Laboratory. The Cambodia cotton was spun into twelve different counts, 20's rising by four counts at a time to 60's, and also 70's counts; each count was spun with six different twist-constants, 3¾ to 5, rising by ¼ at a time; and the Mollisoni into six different counts, 6's rising by two counts at a time to 16's, each count except 16's being spun with five different twist-constants, 4 to 5, rising by ¼ at a time, the 16's being spun with twist-constants 4 and 5 only. Full details are given of the machinery used—hanks, drafts, settings, speeds, and twists. Particular attention was paid to the behaviour in spinning, and a record made of the number of yarn-breakages in the ring frame; observations were also made of the evenness and neppiness of the yarns, and in one appendix are given the Spinning Master's reports and, in another, the mean test-results obtained for lea, single thread, and ballistic tests.

In the course of this investigation the following numbers of tests have been made:

	For Cambodia.	*For Mollisoni.*
Lea strength and counts	6,900	1,400
Single thread strength, extension and counts ..	13,800	5,400
Ballistic work of rupture and counts	3,700	1,700
Twist	13,800	5,400

From the tests on these cottons the following conclusions are drawn:

(1) Cambodia Co. 1 (1927-28) may be spun from carded single roving up to 52's without too frequent bad-spinning troubles, provided a twist-constant of

not less than 4·5 be used, and even up to 60's with twist-constant 5. The yarn at these limiting counts is very weak, however, and very uneven.

(2) Mollisoni cannot be spun above 8's counts if bad-spinning troubles are to be avoided, and even at this count the twist-constant employed must not be less than 4·5.

(3) As is to be expected, for a given twist-constant the unevenness of yarn increases with the fineness of count, while the influence of twist on evenness is practically negligible.

(4) Contrary to expectation, for counts of yarn up to 40's, the numbers of neps per yard do not decrease with decreasing coarseness, probably because small nep nuclei may lie hidden in the coarser counts.

(5) The lea count-strength product for a given twist-constant falls as the fineness of count increases; the maximum such product for any one count of Cambodia is usually obtained by using one or other of the twist-constants 4·25 or 4·5, but with Mollisoni in every count the highest such product is obtained by using the highest twist-constant of the series, viz., 5·0.

(6) The single thread count-strength product for a given twist-constant falls as the fineness of count increases; for the lower counts of Cambodia (up to 36's), and for all counts of Mollisoni, the highest such product is obtained by using the highest twist-constant of the series, viz., 5·0.

(7) The ballistic count-work product for a given twist-constant falls as the fineness of count increases. For practically every count both for Cambodia and Mollisoni the highest count-work product is obtained by using the highest twist-constant of the series, viz., 5·0.

(8) The single thread extension, for a given twist-constant, gradually decreases as the counts become finer; and, for a given count, increases as the twist increases.

181. STUDIES IN THE SAMPLING OF COTTON FOR THE DETERMINATION OF FIBRE-PROPERTIES. PART III. THE SIZE AND RELIABILITY OF A SATISFACTORY SAMPLE. By R. S. Koshal and A. J. Turner. (*Tech. Bull.*, Ser. B, No. 10. Indian Central Cotton Committee, 1930.) The main object of this Part has been the assigning of the minimum number of tests which can be regarded as satisfactory for the determination of the following fibre-properties—length, width, convolutions, strength, and rigidity. The chief method employed has been the comparison of the mean values of small samples of various sizes with the mean value of a large sample, the latter usually comprising 3,000 individual test-values. In order to obtain a large number of samples of any given size, the "moving-mean method" has been used. By inspection of the frequency-distribution of the means of the samples of each size, the proportion of the means lying between any assigned limits has been ascertained, and thence the odds that any single mean of a sample of the given size will lie between these limits. The odds applicable to the same limits for the means of samples of the same size, normally distributed with a probable error of a single observation calculated from that of the whole bulk of the material, have also been given, in order that the experimentally ascertained odds might be compared with the purely theoretical normal odds. The results have also been investigated for each fibre-property by comparing the dispersion of values of small and large samples, and by comparing the actual frequency-distributions of small samples with the theoretical frequency-distribution of a large sample.

The following are the conclusions arrived at as a result of the present analysis:

(1) Although the method of sampling adopted must usually be decided from certain general considerations, we have been able to show that the method of selecting individual fibres from a carefully prepared sliver in which the fibres have been thoroughly mixed shows a bias in favour of the selection of the longer

fibres, and is therefore inferior to the method of selecting small bunches of fibres from different parts of the sliver and testing every fibre in each bunch so selected.

(2) The mean value (*i.e.*, the arithmetic mean) is usually satisfactory as a single value representing all the test-values obtained for a sample, but in the case of fibre-rigidity, for which the distribution is extremely asymmetrical, caution must be exercised in the use of the mean value as it is greatly affected by high individual values, which are sometimes *ten times* as large as the arithmetic mean.

(3) In the case of fibre-length, fibre-width, and convolutions, which give nearly symmetrical frequency-distributions, the mean value and the probable error of a single observation are quite sufficient to indicate the composition of a sample. But in the case of fibre-strength, and more particularly in the case of fibre-rigidity, it is desirable to indicate the composition of a sample by the upper and lower quartiles, in addition to the mean value.

(4) The degree of reliability of small samples is indicated in the following table, which shows the total range, expressed as a percentage of the mean, for which the odds are as indicated that the mean of a random sample of the given size will lie therein:

RANGE (PER CENT. OF MEAN) FOR WHICH THE ODDS ARE AS SHOWN THAT THE MEAN OF A RANDOM SAMPLE WILL LIE THEREIN.

Fibre-Property.	*Odds.*	*Size of Sample.*				
		200.	300.	400.	500.	600.
Fibre-length	20 : 1	18	16	13	11	9
Fibre-width	20 : 1	4	2·7	2	—	—
Convolutions	20 : 1	30	24	20	19	18
Fibre-strength ..	20 : 1	40	23	17	15	13
Fibre-rigidity ..	5 : 1	—	60	55	48	44

Thus from column 3 we see that the odds are 20 : 1 that the mean of a random sample of 200 fibres will lie within a range of 4 per cent. of the mean value of the fibre-width; this is equivalent to 2 per cent. on either side of the mean, seeing that the distribution of values of fibre-width is symmetrical.

(5) In the selection of a certain size of sample as representative, we are guided partly by the degree of reliability of the result for that size, and also by practical consideration of the difficulties of making a very large number of tests. Bearing both these points in mind, we consider the following are the minimum numbers of tests which should be made in the determination of the several fibre-properties by the methods described in Part I.:

Fibre-Property.	*No. of Fibres for Representative Sample.*	*Total Range (Per Cent. of Mean) for which the Odds are 20 to 1 that the Random Sample will lie therein.*
Fibre-length ..	500	11
Fibre-width ..	300	2·7
Convolutions ..	500	19
Fibre-strength ..	500	15
Fibre-rigidity ..	500	48 (odds 5 : 1)

(6) The results obtained in this investigation relate for the most part to Surat 1027 A.L.F. only. But as this cotton was specially selected because previous tests had shown that its individual test-results displayed great variation, it may be inferred that the results obtained from any given number of tests of a certain property of another cotton will be at least as reliable as those obtained from the same number of tests of the same property of Surat 1027 A.L.F.

182. AGRA AND OUDH. *Cotton Experiments.* (*Rpt. on Agr. Stats. of Western Circle,* 1929-30, recently received.) In comparative tests continued at the Aligarh Experimental Farm with A. 19 cotton and various strains from Cawnpore, C. 520 gave the best yields. This is an early ripening cotton with good germinating power, and would appear to be a promising type.

183. CAWNPORE. *Cotton Cultivation.* (*Rpt. on Agr. Stats. of Cent. Circ., Cawnpore,* 1929-30.) The yields of A. 19 cotton on most of the Experiment Farms were very poor in comparison with those of last season, owing to unfavourable weather conditions.

184. MADRAS. *Cotton Experiments.* (*Operations of Dpt. of Agr., Madras,* 1929-30.) Work at Koilpatti and Guntur shows promise of producing a new strain of Karunganni cotton higher in yield and of better quality than the present strains.

185. MYSORE. *Cotton Cultivation.* (*Ann. Rpt. of Agr. Dpt.,* 1928-29.) In connection with the work on cotton the Director of Agriculture states as follows: "The main selection of our Sannahatti (selection 69) has become increasingly popular. Arrangements were made for the inspection of crops of this selection over a considerable area by the Senior Assistant Botanist in charge of cotton-breeding. Cotton from fields selected by him was collected and ginned separately in the gins on the Babbur Farm, and the seed obtained was sent out in sealed bags as certified seed. About 7,000 acres distributed over all the important cotton-growing areas were sown with this seed, the results being, in general, favourable. Arrangements have been made during the present year for the distribution of certified seed on a larger scale, and with favourable seasonal conditions we should have about double the area. This arrangement, coupled with the formation of co-operative societies for the growing and marketing of the cotton which is now being actively taken up, should lead to the replacement of the local mixed crop within five years."

186. SOWING DATE EXPERIMENTS WITH PUNJAB-AMERICAN COTTONS AT LYALLPUR, 1926-29. By Trevor Trought. (*Agr. J. of India,* xxv., 4, 1930, p. 297.) The results of experiments with different sowing dates of Punjab-American cotton are presented and discussed. Diagrams of daily growth, daily flowering, and daily bolling are given. It is suggested that differences from the optimum between the root's and shoot's environments may account for the differences found between different sowing dates, by inducing a sub-optimal root/shoot ratio, which has a cumulative effect throughout development. The general conclusion is drawn that cotton sown late has a greater rate of growth and an increased flower and boll production, and that sowing between June 1 and 15 can safely be recommended as a general practice. Some practical advantages of this later sowing are discussed.

187. COTTON IN THE PUNJAB. (*Rpt. on Operations of Dpt. of Agr.,* 1929, Pt. II., Vol. II.) The following experiments are described: Varietal, hoeing, broadcast *v.* sowing in lines, manurial, hedging, and continuous cropping experiments at Hansi Station; varietal and manurial trials at Sirsa Station; rotational, varietal, manurial, and spacing experiments at Lyallpur Experimental Farm; varietal, irrigation, and manurial tests at Montgomery Station; varietal, manurial, broad-

cast *v.* line sowing, and flat *v.* ridge sowing at Multan Station; cultural, rotational, continuous cropping, and manurial experiments at Sargodha Station.

188. COTTON IN THE PUNJAB. (*Seasonal Notes, Punjab*, vii., 2, 1930.) It is stated in a paper by S. D. Singh that some of the Hansi selections, especially M-60-A-2, have been gaining in popularity, and this strain now occupies over 70,000 acres in the Hansi circle.

The question of damping of cotton is considered by M. Afzal, and recommendations made (such as picking when dry, drying after picking, and storage in dry godowns, etc.).

The notes also contain a concise little article on limiting factors in crop production (V. H. Prideaux), and a short note on 289-F. cotton on B.C.G.A. farms (W. Roberts).

189. THE SUCCESSFUL MANAGEMENT OF COTTON MILLS. By H. D. Martin. (Pubd. by Ronchhodlal Amratlal, Ahmedabad. Abstr. from *Int. Cott. Bull.*, ix., 33, 1930, p. 168.) A versatile work containing sound advice on every branch of the cotton industry. The book is well worthy of the perusal of everyone connected with mill work, from manager downwards.

190. BOMBAY COTTON ANNUAL, 1929-30, No. 11. The usual valuable compilation of statistics relating to crops, exports, imports, prices, stocks, consumption, Government notifications, etc., necessary for all who are interested in the production, distribution, and consumption of Indian cotton.

COTTON IN THE EMPIRE.

191. The following reports have recently been received:

KENYA COLONY: Ann. Rpt. of Dpt. of Agr., 1929.

SOUTH AFRICA: Farming in S. Afr., Ann. Rpt. Dpt. of Agr., June, 1930.

SUDAN: Ann. Rpt. of Dpt. of Agr. and Forests, 1929.
Rpt. of Finan. Admin. and Condition of the Sudan in 1929.

WEST INDIES: Econ. Conditions in the Br. West Indies, 1930. (J. Wilson Goode.)
St. Kitts-Nevis: Rpt. of Agr. Dpt., 1929-30.
St. Lucia: Rpt. on Agr. Dpt., 1929.

192. ASIA: CEYLON. *Cotton Cultivation in the Hambantota District.* By W. R. C. Paul. (*Trop. Agriculturist*, lxxv., 6, 1930, p. 375.) The author avers that the progress of cotton cultivation in the Hambantota district has been impeded by several factors, but as it has proved to be one of the few crops in which marketing difficulties do not arise it is not likely to be abandoned. The depression in cotton prices during the last few years has had a discouraging effect on the growers, who have also to contend against such other difficulties as damage to chenas by stray cattle and wild animals, and the prevalence of malaria. The average yields of seed cotton in chenas are between 2 and 2½ cwt. per acre. Neglect to plant cotton in definite rows and to carry out regular weeding is common, and much higher yields could be obtained if attention were only paid to these two conditions. The experimental work of the Department has been confined mainly to the selection of suitable varieties and strains for the district. The results of the trials carried out since 1921 have indicated the general superiority of Cambodia cotton, an Indian variety; a local selection of strain No. 15 of this type has given the best yields so far. Further selection work will be carried out in the future, while comparative trials with other varieties will also be continued.

Weather conditions play a most important rôle in cotton cultivation. Periods of heavy rainfall experienced either during the early or later stages in the growth

of this crop result in much damage and poor yields. During certain years—*e.g.*, the 1926-27, and 1929-30 seasons—when abnormal rain was experienced in the district, there was a considerable effect on the crop of the Experiment Stations.

With improvements in methods of cultivation, and the use of the most suitable strains for the district, which form part of the future programme of the experimental work in cotton carried out by this Department, it is hoped that cotton cultivation will occupy a foremost place in the Hambantota district.

193. African Cottons: Tentative Standards. (*Rpt. of the Millowners' Asscn., Bombay*, 1929, pp. 155, 166. Abstr. from *Summ. of Curr. Lit.*, x., 24, 1931, p. 666.) Correspondence relating to the establishment of standards for African cottons in the Indian market is reproduced and the preparation of standards for Kampala (Masaka), Busoga, and Jinja (including Teso, Lango, Bukedi, and Northern Province) cottons is suggested.

194. Gold Coast. *Cotton Experiments*, 1928-29. (*Bull. Imp. Inst.*, xxviii., 4, 1930, p. 502.) Cotton trials at Tamale in the Northern Territories and at Kpeve in Southern Togoland are summarized in the Gold Coast *Yearbook*, 1929. At Tamale there have been tested 16 types in all, of which 7 were obtained from the Empire Cotton Growing Corporation, 1 from Turkestan, 2 from Kpeve, 4 were native types, and the other 2 were Nigerian Ishan and American Allen. During the trials promising individuals were found only in one native type (Ganvelga) and in the Allen, and these individuals have been multiplied and further selections made. Three strains, all of American Allen, have emerged which are of distinct promise, and they are being purified by a system of discarding and selection, with the final aim of obtaining a supply of seed for careful trials on farms of the district.

The behaviour that is sought is heavy late flowering. Two main flowering-peaks occur during the life of the plant, the second of which always occurs during the harmattan (November to January), and is quite independent of the exact date of planting. The first peak occurs during the rains several weeks before the harmattan, at a time dependent upon the date of planting. The flowers which occur during the rains are practically all destroyed or shed, whereas those produced during the harmattan yield cotton. Naturally, a type in which early flowering did not occur, but which saved its vigour for flower-production during the favourable dry harmattan season, would stand a fair chance of being commercially profitable.

It has been proved that early flowering cannot be suppressed by altering the planting date, and that manuring increases the yield but does not lessen the percentage of flowers lost during the first flowering-peak. In other words, good yields occur only in strains which suppress their early flowering and blossom in the harmattan, and all the selection work now is being aimed at producing a strain conforming as closely as possible to this ideal type.

The problems of cotton-growing in Togoland appear to be fundamentally different from those of the Northern Territories. In the first place, Nigerian Ishan and other types suit Togoland; climatic conditions are also far more favourable and yields are correspondingly better. The work at Kpeve consists, therefore, in selecting higher yielding strains from the types now grown in Togoland, and not, as in the Northern Territories, in trying to find a type that will grow at all.

195. *Cotton Development, Northern Territories*, 1929-30. By J. E. Symond and T. L. Williams. (*Yearbook*, 1929, Gold Goast Paper XXXVI. Issued by *Dpt. of Agr.*, 1930.) The report is divided into the following sections, each of which is discussed in detail: I. Improvement of strains by selection and breeding. II. Continued study of physiology and disease on: (*a*) Optimum time planting,

(*b*) Manurial experiments, (*c*) Further field-scale trials with Ishan variety. III. (*a*) Cotton as part of rotation farming, (*b*) Small observation plots of Ishan variety at out-stations. The report is well furnished with graphs and tables of statistics.

196. KENYA COLONY. *Cotton Cultivation.* (*Ann. Rpt. Dpt. of Agr.*, 1929.) From this report, a copy of which has recently been received, we learn that as regards acreage planted, growth of crops, and cultivation given to cotton, 1929 was the record year. On the Coast the large acre yields and the fixed unvarying price throughout the buying season, together with much instruction, induced more interest and activity. Prices paid for the 1928-29 crop were 17 to 18 cents for "A" quality, and 7 to 9 cents for "B" quality; 1,784 bales were produced in Kavirondo and 200 on the Coast, a total of 1,984 bales. Large quantities of Kenya seed-cotton are carried over the border into Uganda, the ginners stating that they are unable to pay the high prices obtaining over the border.

197. NIGERIA. *Cotton Experiments.* (*Bull. Imp. Inst.*, xxviii., **4**, 1930, p. 503.) According to a report on the work conducted by the Botanical Branch, Southern Provinces, during the first six months of 1930, the 1929-30 season was an exceptionally favourable one for cotton at Ibadan. From the multiplication plots on Moor Plantation approximately 11 tons of pure Ishan A seed were produced for the Meko district, the average yield being 513 lb. of seed-cotton to the acre. Several other strains under trial, while excellent in some characters, failed agriculturally, and have been discarded. The F_1 of an Ishan cross was grown. The investigation into the aspects of intercropping cotton with yams was repeated; the results generally confirm the conclusions previously recorded.

The report on the Botanical Branch of the Northern Provinces for the same period states that pure-line selection of cotton has been continued. In regard to the introduced varieties there is little to report as yet; the strains at present under observation are: H 21, Acala, Mesowhite, A 12, U 4, Z 1, Cawnpore, Cambodia, Over-the-Top, F 285, Co. 1, Co. 2, C 7, A 10, 546.

In his report, covering the same period, Mr. O. B. Lean, Entomologist, states that the results of the survey carried out in the Benue Province on ordinary Munshi and the improved Ishan A cottons agree with the results obtained in the previous season. The Munshi is more free from insect and other damage, and suffers far less from bud and boll shedding. On the other hand, the Ishan produced many more flowers. Cotton stainers were rare, but injury was caused by various species of Pentatomidæ. Of bollworms, *Diparopsis castanea*, Hmps., was the most common, and Jassid also caused injury to the cotton early in the season, but the plants recovered and the yield was greater than was anticipated.

[*Cf.* Abstract **510**, Vol. VII., p. 327.]

198. SOUTHERN RHODESIA. *Marketing of the* 1930 *Cotton Crop.* By T. G. Hesse. (*Rhod. Agr. Jour.*, xxvii., **11**, 1930, p. 1173.) Deals with the difficulties encountered owing to the world-wide trade depression. The author states that, taking it all round, the crop was a success, as the average yields per acre were far in advance of anything previously achieved in Southern Rhodesia. Particular interest attaches to this aspect, as it was a grand-scale trial of the new U.4 varieties provided by the Empire Cotton Growing Corporation. Had jassid-resistant cottons not been available, very little cotton would have been planted, and yields would have been an extremely doubtful quantity. In the matter of quality, too, an improvement has been effected, particularly regarding uniformity of staple—a most important factor.

Speaking of the outlook for the next crop, the author writes as follows: "Thanks to the U.4 cotton we have the assurance that average yields per acre will be materially higher than in the past. Therefore the cost of production per

pound of cotton produced must be lower, and in this the most important step has been taken to meet changed economical conditions. As every farmer must realize, his main chance of surviving the abnormal conditions of today lies in reducing costs of production. U.4 is doing this for us."

199. SOUTH AFRICA. *Review of* 1929-30 *Cotton Crop.* (*Crops and Markets*, ix., 4, 1930, p. 52.) Except for the Weenen area, where the crop was practically a total failure through hail and floods, the weather conditions were very favourable, being exceptionally good in Swaziland and the Eastern Transvaal. Hot dry winds caused shedding in the Northern and Western Transvaal; late cotton was affected by early frosts in the Orange River area; Zululand suffered some damage through beetle pests; and other areas also experienced localized attacks from bollworm and jassid.

Prospects for the 1930-31 *Crop.*—As a result of the unprecedented drought, very little cotton was planted before the middle of December, practically no rain having fallen during October and November, the normal planting months. Owing to the lateness of planting, it is feared that prospects will be somewhat disappointing, especially in the areas with a short season.

200. *Cotton Cultivation.* (*Farming in South Africa*, v., 56, 1930, p. 365.) It is stated that the area under cotton in the Union is expanding rapidly despite low prices. At the Rustenburg Experiment Station experiments with fertilizers, crop rotations, and varieties are being continued. Breeding and selection work has progressed and suitable seed for Middleveld conditions is being multiplied on selected farms. At Barberton the Empire Cotton Growing Corporation has continued its useful work on jassid-resistant cotton. The U.4 type of cotton developed there has given most satisfactory results, which have contributed largely to the spirit of optimism prevailing among the cotton farmers in the Low-veld. Good progress has been made at Kakamas, where an officer has been placed to carry out irrigation experiments. The bollworm continues to be the most serious pest; could this be overcome the future of the Union's cotton industry would be assured.

201. COTTON CULTURE IN THE UNION OF SOUTH AFRICA. By P. Koch. (*Pan-Afr. Agr. and Vet. Conf., Pretoria*, 1929. *Papers of Agr. Section*, p. 144.) A general account of the industry, dealing with cotton experiments, available cotton lands, production of lint, costs of production. The author states in conclusion that the amount of cotton produced in South Africa at present may not be large, but it is encouraging if one considers that the culture of this crop is of recent date and practically unknown to many farmers of the country. Although early hopes have not been realized, it is considered that the cotton industry has at last been placed on a sound footing, and that the plant will continue to play an important part as a rotational crop in large areas of the middle and low veld of the Union and Swaziland.

202. SWAZILAND. *Cotton Cultivation.* (*Col. Rpt.*, No. 1501, 1929. Abstr. from *Trop. Agriculture*, vol. viii., No. 2, 1931, p. 42.) The cotton crop shows an improvement each year, and although the acreage under cultivation was less during the period under review, returns were greater, due to the improved type of seed and especially to the jassid-resisting varieties introduced by the Empire Cotton Growing Corporation. As more of the improved seed becomes available larger quantities will be grown. Climatic conditions were not unfavourable, and insect pests were markedly less.

203. SUDAN. *Cotton Cultivation.* (*Ann. Rpt. of Dpt. of Agr. and Forests*, 1929, recently received.) During the year there was a continued increase in the output of rain-grown cotton from the Southern Provinces—notably the Nuba

Mountains area, but until there was some indication of the probable trend of prices, it was decided not to increase the acreage save in particular localities.

Demand for pumping plants in Khartoum and Berber was well maintained despite low cotton prices, whilst small pumping plants to replace sakias were in favour in Halfa Province.

The research work on Blackarm—the most serious disease of cotton in the Gezira—was continued by the Government Botanist, whilst investigations on Leaf Crinkle disease were carried out by the Assistant Government Entomologist.

204. *Ginning Factories.* (*Rpt. on Finan. Admin. and Condition of the Sudan in* 1929, recently received.) It is stated that nine factories are in operation, which deal with the cotton crop of the country other than that grown by irrigation in the Gezira—viz., at Port Sudan and Atbara, to deal with the crops north of Khartoum; at Talodi and Kadugli, for the Nuba Mountains crop; and at Torit, Yei, Shukoli, and Meridi for the Southern Provinces. It is anticipated that the new factory at Port Sudan will be in operation in time to deal with the 1930-31 crop. A second factory is being added at Kadugli to deal with the increased crop in the surrounding area.

205. UGANDA. *Crop Prospects*, 1931. (*H.M. East Afr. Dpt. Trade and Infmn. Off.*) Prospects continue to be favourable, and the latest information is to the effect that rain is falling in many of the important areas. No serious reports of disease have been received, and a more than average yield is expected. The yield is estimated in unofficial circles to reach 200,000 bales, but such estimates must be taken with a certain amount of reserve because of the late planting of the crop.

206. The latest report from the Dpt. of Agriculture on the cotton crop states that the July-August sowings are generally expected to yield above an average crop. The dry conditions prevailing during December have affected the later sowings and only small yields can be expected from these. The staple length and grade in general are above the average.

207. CANADA. *New Cotton Mill.* (*Int. Cot. Bull.*, ix., **33**, 1930, p. 129.) The Goodyear Tyre Company have established a new cotton spinning and weaving mill in Quebec for the manufacture of motor-car tyre fabrics. The new plant, which will give employment to 700 operatives, will contain 40,000 spindles, and will consume 11,500,000 lbs. of raw cotton, mostly of Egyptian staple.

208. WEST INDIES. *Cotton Cultivation.* (*Trop. Agr.*, viii., **1**, 1931, p. 11.) From the notes compiled by the Commissioner of Agriculture we learn that the Cotton Research Officer, Mr. S. H. Evelyn, whose cotton breeding work is being directed by Dr. Harland, has laid out an ambitious programme of work, and confidence is felt generally amongst cotton growers of St. Vincent that the local cottons will shortly be restored to their original condition of purity of seed.

Dr. Harland, reporting on a recent visit paid to Montserrat, states that while there has been some contamination and hybridization in the cotton fields in certain districts, the Montserrat cotton is pure at its source, and the seed distributed by the Agricultural Department is pure line pedigree seed.

An attempt is being made to improve agricultural conditions in the small island of Anguilla, and an Agricultural Instructor is to be appointed. Sea Island cotton has been successfully grown by the peasantry in the past, and it is hoped to stabilize this industry.

209. BARBADOS. *Cotton Cultivation.* (*Rpt. on Dpt. of Sci. and Agr.*, Barbados, 1929-30.) The effective nature of the close season for cotton carried out in 1929 is evidenced by the fact that no pink bollworm has been reported in the island during the period under review. A pamphlet has been issued (No. 4 of 1930)

advocating the extensive planting of windbreaks, and a much closer spacing, which it is anticipated, given a favourable season, will result in a greatly increased yield from the 2,000 acres which planters propose to place under cotton this year.

The work on cotton breeding has been abandoned, as reports on samples of cotton continue to show Barbados cotton to be superior to all other lints, and it has been felt, therefore, that greater success will be achieved by the rigorous selection of the best types of seed rather than by the introduction of new strains of cotton from outside.

210. *Cotton Prospects.* (*W. Ind. Comm. Circ.*, xlvi., 842, 1931, p. 14.) The cotton crop is stated to be in excellent condition, and a good yield is anticipated. If a good market can be obtained it will enable planters to tide over the severe losses caused by the drought to the sugar crop.

211. St. Vincent. *Cotton Cultivation.* The latest report received is to the effect that the cotton crop in the island looks very promising. First pickings are being made. Aphis was present during October and November, but was not responsible for any damage. Stainers have made their appearance in some localities, and a few cotton worms (*Alabama argillacea*) have recently been noticed.

COTTON IN EGYPT.

212. Endeavours of Egypt in Cotton Production. By Professor Kamel Bey. (*Pan-Afr. Agr. and Vet. Conf., Pretoria*, 1929. Papers of Agr. Section, p. 146.) Discusses briefly the early history of cotton, control of irrigation, use of artificial fertilizers, seed supply.

213. Developments of the Existing System for Seed Supply of Cotton in Egypt. By W. L. Balls. (*Tech. and Sci. Serv. Bull., No.* 100, Min. of Agr., Egypt, 1930.) The subject is dealt with as follows:

A. (1) The supply of pure seed:
- (*a*) Multiplex system, for several varieties.
- (*b*) Areas planted annually.
- (*c*) Sub-division of the total cotton areas.
- (*d*) General considerations and special terms.

(2) Elimination of contaminated seed.

B. (1) Economic research and technical study to decide on types for distribution.

(2) Advice, education, and propaganda based on such study.

(3) Proscription of unsuitable types.

214. The Operation of the Seed Control Law upon the Pedigree of Cotton Seed in Seasons 1926 to 1930, with a Discussion of Evasions of the Law. By W. L. Balls and A. Bedevian. (*Tech. and Sci. Serv. Bull., No.* 104, Min. of Agr., Egypt, 1931. Pubd. Govt. Press, Cairo, price P.T.10.) The outstanding feature of the situation, as set out in this Bulletin, is the alarming rapidity with which evasions of the Law have increased. It is believed, however, that effective measures of prevention have been applied.

COTTON IN THE UNITED STATES.

215. American Textile Notes. (*Text. Rec.*, xlviii., 572, 1930, p. 73.) "It is estimated that the value of the crop now being gathered will be $853,000,000, compared with $1,320,000,000 for the previous crop. . . . The carry-over is

larger than last year, with both grade and staple lower, and less of it is tenderable."

216. COTTON CONSUMPTION. (*Text. Rec.*, xlviii., **574**, 1931, p. 39.) For the first time since the American Civil War, the world's consumption of American cotton has been exceeded by that of other growths. During the second half-season, the consumption of American cotton amounted to 5,940,000 bales, as compared with 6,067,000 bales of other growths.

217. REPLACING AMERICAN COTTON BY EGYPTIAN UPPERS. (*Int. Cot. Bull.*, ix., **33**, 1930, p. 69.) Discusses the recent advances in the use of Uppers in place of American cotton.

218. ACREAGE REDUCTION CAMPAIGN. (*Int. Cot. Bull.*, ix., **33**, 1930, p. 60.) The Federal Farm Board, in October, formally announced the opening of a drive to effect a reduction of cotton acreage and a readjustment of farm programmes in the Cotton Belt. In co-operation with the Department of Agriculture a series of conferences will be held to further this programme.

219. BETTER COTTON NEEDED. (*Int. Cot. Bull.*, ix., **33**, 1930, p. 56.) Secretary Hyde, in an address to the Chambers of Commerce of East Texas, said that America was losing business because the staple length of her cotton was becoming too short, and the quality was getting lower; also, there was not sufficient price inducement to grow longer staple.

220. REPORT AFTER A VISIT TO THE U.S. COTTON BELT, 1930. By N. S. Pearse. (*Int. Cot. Bull.*, ix., **33**, 1930, p. 33.) The drought caused less damage to the cotton than was anticipated, since the tap roots were well established before its commencement. Weevil is less pronounced than usual. Farmers are holding their crops for higher prices. Picking costs are reduced. The activities of the Federal Farm Board and of the Co-operative Societies are discussed.

221. AMERICAN COTTON: DETERIORATION. Southern Textile Association. (*Cotton*, U.S., **94**, 1930, pp. 1121-2. Abstr. from *Summ. of Curr. Lit.*, x., **20**, 1930, p. 531.) A report is given of an address by the President of the Southern Textile Association, in which the variation in staple of American cotton is discussed. An increase in the percentage of cotton of staple less than $\frac{7}{8}$ inch during the last year, and tests of bales from Mississippi, in which the staple varied from very short up to $\frac{13}{16}$ inch, are reported. It is claimed that there can be no great improvement until each individual bale is bought on its own merits and higher prices paid for better staples. The State Agricultural Colleges are blamed for recommending the planting of early maturing varieties. Recently, however, the colleges have recommended the planting of longer stapled varieties. With improvement in staple and character, a great improvement in ginning is also required. The many worn-out gins now running injure the staple and fail to remove all the lint from the seed. Another cause of ginning damage is traced to the many different varieties of cotton raised in a single community, and the ginner omitting to change the adjustments and speed between varieties.

222. COTTON EXPERIMENTS IN ALABAMA. (*40th Ann. Rpt. Agr. Exp. Sta.*, Alabama, 1929.) Results are given for the following experiments: Rotation; Time of turning vetch for cotton and corn (early was best for cotton, late for corn); A comparison of manure, commercial fertilizer, and vetch for cotton and corn; Nitrate of soda *v.* sulphate of ammonia for cotton; Varietal tests; Cotton and corn breeding; Influence of superphosphate used in connection with winter legumes on yield of cotton.

223. COTTON EXPERIMENTS IN ARKANSAS. (*42nd Ann. Rpt. Agr. Exp. Sta.*, 1930.) Describes cotton breeding, spacing, and varietal experiments, and also

the following in relation to fertilizers: Co-operative experiments; rates of application of fertilizers; home mixed *v.* factory mixed; placement of fertilizers; varying formulas; sources of nitrogen; ratio of organic nitrogen in fertilizers; the effects of nitrogen, phosphorus, and potash on the performance of the cotton plant.

224. CALIFORNIA. *Cotton Industry.* (*S. Calif. Crops*, vii., 1, 1931.) Three records were established this year. First, acre yields were the highest, costs of production were the lowest, and prices were the lowest since cotton-growing has been on a real industry basis. The influence of the first two has served to offset to a degree at least the results of the third, and the close of the season will find California cotton growers in a better position than those in other sections of the country.

225. FLORIDA. *Cotton Investigations.* (*Rpt. of Agr. Exp. Sta.*, 1929, recently received.) During the year cotton-breeding experiments to produce better strains for Florida were continued, together with investigations on boll weevil control, rust disease, seedling diseases, and cotton wilt.

226. COTTON CROP: COSTS OF CULTIVATION IN NORTH CAROLINA. By F. C. Vilbrandt. (*Cellulose*, 1, 1930, p. 210. Abstr. from *Summ. of Curr. Lit.*, x., 22, 1930, p. 589.) Cost data on cotton growing in North Carolina are given and discussed, and it is pointed out that there is a need for investigations into the possibilities of reducing the cost of harvesting cotton, of extending the use of short-staple cotton for the manufacture of rayon, and of utilizing the entire cotton plant as a source of cellulose for the rayon industry.

227. COTTON FERTILIZER TESTS IN TEXAS. (*Texas Sta. Rpt.*, 1929. Abstr. from *Exp. Sta. Rec.*, 63, 5, 1930, p. 439.) Results obtained since 1926 at the Station without irrigation and at Iowa Park under irrigation indicate that fertilizers have no appreciable influence on the length of lint. All fertilizer treatments increased the percentage of 5-lock bolls in comparison with untreated soil, and, furthermore, the percentage appeared to rise as the quantity of phosphorus in the fertilizer was increased. Heavy applications of fertilizers, 600 to 800 lbs. per acre, resulted in slightly larger bolls than the lighter applications. Bolls developing early in the season averaged from 15 to 20 per cent. larger and produced slightly longer lint than those developing later in the season.

228. COTTON INVESTIGATIONS IN TEXAS. (*Texas Sta. Rpt.*, 1929. Abstr. from *Exp. Sta. Rec.*, 63, 5, 1930, p. 439.) A form of chlorophyll deficiency in which the adult cotton leaves are marked with irregular areas devoid of chlorophyll appeared to be a type of cytoplasmic or maternal inheritance, and has been found in the Truitt, Trice, Acala, and Mebane varieties. Plants so affected generally lack vigour, resulting in poor stands and lower yields. The progeny of self-fertilized seed from a plant of Mebane cotton produced several different types of boll chimeras. Studies of the inheritance of the virescent yellow type of chlorophyll deficiency continued into the F_4 generation, indicating that it is determined by a single factor. The F_1 of crosses between red and green leaved plants all had red leaves, and the F_2 segregation indicated that a single factor was involved. Red leaf also was dominant in F_1 to virescent yellow.

In the F_1 of hybrid lines of crosses of Durango on Mebane, Lone Star, Express, Westex, Sea Island, and Pima, the cluster type of fruiting of Durango was found recessive. A number of characters, as long lint, petal spotting of the flowers, colour of pollen, and length of vegetative and fruiting branches of the Sea Island and Pima parents, were dominant to these characters in Durango in F_1. Efforts to develop a cotton with fruiting and vegetative characters better adapted to harvesting by machinery than varieties now grown are described.

229. AMERICAN COTTON MILL: WASTE RECORDING. (*Melliand*, **2**, 1930, p. 6. Abstr. from *Summ. of Curr. Lit.*, x., **22**, 1930, p. 622.) An article on the reduction of waste in cotton mills, in which a table is reproduced showing the waste record for a period of nine months in a Southern States mill of approximately 15,000 spindles and 324 looms, manufacturing sheeting and using cotton averaging strict low middling $\frac{3}{4}$ to $\frac{7}{8}$ inch. A second table shows the number of stoppages of 1,134 looms on night and day work, and their causes, whilst a third table shows the weight of each of 24 bales of cotton as received and after twenty-four hours in the opening room.

COTTON IN FOREIGN COUNTRIES.

230. BRAZILIAN COTTON: GRADING. (*Leipz. Woch. Text. Ind.*, **45**, 1930, p. 870. Abstr. from *Summ. of Curr. Lit.*, x., **24**, 1931, p. 666.) The Ministry of Agriculture, Brazil, has set up type samples of cotton according to three main grades for staple length—short (22-28 mm.), medium (28-34 mm.), and long (above 34 mm.). Each of these is subdivided into five "whole types," according to cleanliness; these are numbered 1, 3, 5, 7, 9, the last being the worst, corresponding with about 20 per cent. of trash. There are also four "half types" numbered 2, 4, 6, and 8.

231. NOTES ON COTTON MILLS IN CHINA. (*Econ. Conditions in China*, 1929-30 [E. G. Jamieson], p. 57.) The twelve months' (July, 1929, to June, 1930) trading for cotton mills in China was exceptionally good; most of the profits, however, were made during the first six months. After the turn of the year, the depression caused by the decline in silver and with civil war in China again rampant, prices of yarn declined and stocks increased so that at the end of the period some mills were ready to curtail their production.

232. CHINESE COTTON INDUSTRY. (*Text. Rec.*, xlviii., **573**, 1930, p. 88.) According to statistics obtained from the Chinese Cotton Mill Owners' Association, there were 127 cotton mills equipped with 3,969,522 spinning spindles, 231,684 twisting spindles, and 28,322 looms in the whole of China on January 1, 1930. During 1929 these mills consumed approximately 1,217,350,000 lb. of raw cotton, as compared with 1,089,333,000 lb. during the previous twelve months. The annual production was placed at about 942,573,200 lb. of yarn and 591,181,520 yds. of cloth in 1929, in comparison with 880,000,000 lb. of yarn and 586,000,000 yds. of cloth in the previous year.

233. ASSOCIATION COTONNIÈRE COLONIALE. We have received a copy of *Bulletin No.* 1, 1931. This number is presented in a new and enlarged form which renders it a more attractive publication. An interesting history of the Association since its inception is included, together with accounts of cotton cultivation in Senegal, Sudan, Morocco, Algeria, Togoland, New Caledonia, etc.

234. FRENCH COTTON INDUSTRY. (*Text. Rec.*, xlviii., **574**, 1931, p. 39.) Cotton manufacturing enterprises, including bleaching, dyeing, and finishing plants, employ about 229,000 operatives. Weaving sheds in France are said to have on an average about 400 looms each.

235. COTTON IN THE FRENCH COLONIES. Vol. v., No. 2 of *Coton et Culture Cotonnière* contains the following interesting articles: "Influence de divers facteurs: époque de la récolte, irrigation, recépage, sur la qualité des fibres du cotonnier," by F. Heim de Balsac and Miege; "La production cotonnière dans les Colonies françaises. État actuel et chances d'avenir de la culture de coton au Cambodge," by Heim de Balsac and Sibert. "La culture du cotonnier dans l'Inde britannique" (Ray C. P. Boone) is continued, and the volume also contains abstracts of cotton literature.

236. Japanese Cotton Industry: Statistics. By M. Paske-Smith. (*Int. Cot. Bull.*, 8, 1930, p. 380. Abstr. from *Summ. of Curr. Lit.*, x., 22, 1930, p. 622.) Statistics are given showing the number of companies, factories, spindles, and looms of the Japanese cotton industry, the output and export of yarns and cotton cloth, import of cotton cloths at Shanghai from Japan, the United Kingdom, and the United States, and Japanese exports of cotton hosiery, rayon fabrics, and rayon yarns. Changes in recent years are discussed.

237. Netherlands Cotton Industry. (*Text. Rec.*, xlviii., 574, 1931, p. 39.) Comprises approximately 1,163,000 spindles and 58,000 looms, and produces about 75 per cent. of domestic requirements.

SOILS AND MANURES.

238. Erosion as a Factor in Soil Determination. By M. F. Miller, Chairman of Agr. Section, Amer. Ass. for Adv. Sci., Cleveland, Decr., 1903. (Abstr. from *Science*, 73, 1931, p. 79.) "Under favourable conditions for erosive action, erosion may be the principal contributing factor responsible for soil determination." "Erosion is also of importance in determining the character of both virgin and cultivated soils, and . . . has a great significance to agriculture." "Under agriculture, particularly a type . . . which makes no provision for soil preservation, . . . losses may be tremendously magnified." These observations, though trite, are quoted as emphasizing the problem that lies before us, and to which we are at last beginning to awaken. This paper should be read by all interested. Some striking figures are given: thus the Mississippi is estimated to carry away yearly 630,000 tons of nitrogen, 62,000 of phosphorus, and 1,626,000 of potassium. Other observations show the greater loss that occurs under continuous cropping than under rotation, under bad than under good cultivation, and so on. There is an interesting discussion of the effects of different systems of farming.

239. Soil Erosion Prevention in Nyasaland. By P. H. Haviland. (*Rhod. Agr. Jour.*, xxvii., 12, 1930, p. 1258.) The author states that Nyasaland is to be congratulated on the amount of anti-soil erosion works in existence. At the present time about 75 per cent. of the total number of tea estates have been either partially or wholly protected against soil washing, and the results have undoubtedly proved the expenditure economical. In regard to tobacco and cotton, which are generally produced on much flatter slopes, it is only comparatively recently that the ravages of erosion have been recognized, and steps are being taken to deal with the menace. The author is of opinion that in a few years 90 per cent. of the European-owned cultivated lands of Nyasaland will be protected.

240. Studies on Three Important Soil Series of Nyasaland. By A. J. W. Hornby. (*Bull. No.* 3, Agr. Ser. Dpt. of Agr., Zomba, Nyasaland, 1930.) Further studies are presented of samples of soils from series in Nyasaland which have received considerable attention in past years. This is an attempt to characterize the soils more accurately, both from a climatic and chemical point of view. Although they differ but little in physical properties, there is considerable difference in the composition of the clay fraction. Indeed, the physical properties themselves may be said to vary with that composition and with the amount of clay in the soil. The difference in distribution of acidity may be found to be a good method of characterizing the soils. The ratio silica to alumina plus iron oxide is of importance in determining the properties of the clay. That it varies according to the amount of leaching to which the soils have been subjected receives support in this paper. The large crop adaptation of these soils is also stressed.

241. Cotton Lint and Seed: Effect of Soil Conditions on Quality and Yield. By F. C. Vilbrandt and J. R. Murphy, jun. (*Cellulose*, **1**, 1930, p. 142. Abstr. from *Summ. of Curr. Lit.*, x., **21**, 1930, p. 580.) Plots of cotton land were selected offering extreme soil conditions, and both the seeds and fibres from the cotton grown on the various soils were examined. Since all the plots were purposely selected from the same farm, the weather conditions were constant and likewise the strain of seed planted on all the plots was the same. The lint was classified into good, medium, green, and dead fibres, and the nitrogen and oil contents of the seeds were determined. The results are tabulated. These results show that the lint per cent. as a criterion for determining the merit or demerit of cotton fibre is misleading. A high lint per cent. ordinarily indicative of a superior cotton fibre may be due to the stunted or immature growth of the seed rather than to the full development of the fibre. The cotton seed is affected to a greater extent by extremes of soil condition than is the cotton fibre. The nitrogen content of the seed is fairly constant, ranging from 5 to 6 per cent. on the kernels, while the oil content is more variable. Where the condition of the soil is fairly constant the oil content of the cotton seed is a function of the percentage of normal fibres (good or medium) in the sample. The oil content of the seed is affected by soil conditions and by the maturity of the seed on the stalk.

242. Further Studies on the Relationship between the Concentration of the Soil Solution and the Physicochemical Properties of the Leaf-Tissue Fluids of Cotton. By J. A. Harris. (*J. Agric. Res.*, vol. xli., No. 11, 1930, p. 767.) The present paper is one of a series dealing with the measurement of the relationships between the properties of the soil and the characteristics of the crop plant produced. When suitable data are available, the relationships between the characteristics of the plant and the salinity of the soil may be satisfactorily expressed in terms of the correlation coefficients. While salinity is an advantageous soil property for a first investigation, there is every reason to believe that the method may be extended to other soil properties.

The present paper confirms and extends the findings of the first study of the relationship between the salinity of the soil and the tissue-fluid properties of Pima Egyptian, Meade Upland, and Acala Upland cotton, in that positive correlations are demonstrated between the electrical conductivity, the chloride content, and the sulphate content of the soil on the one hand, and the freezing-point depression, specific electrical conductivity, and chloride and sulphate content of the leaf-tissue fluids of the plant on the other. The coefficients obtained in the present study are lower than those found in the first investigation. The reasons for the differences are discussed.

The present findings extend those of the earlier investigation in that they are based on two additional variables for the soil (chloride content and sulphate content) and on an additional variable for the tissue fluids (sulphate content). The fact that statistically significant correlations have been obtained for all the combinations of the variables of the soil and the plant demonstrates the wide usefulness of the method of research employed. The present study is admittedly preliminary in nature. It has fulfilled its purpose by confirming and extending previous results, and by showing that physiological investigations of this kind may be carried out in conjunction with ordinary field-plot studies. When the refinements of technique that may be made at many points are available, results of far greater exactness and wider significance may be expected.

[*Cf.* Abstracts **269**, Vol. IV., **364** and **365**, Vol. VI.]

243. A New Method of Measuring the Comparative Rate of Percolation of Water in Different Soils. By G. J. Bouyoucos. (*J. Amer. Soc. Agron.*, xxii., **5**, 1930, p. 438. Abstr. from *Exp. Sta. Rec.*, lxiii., **5**, 1930, p. 421.) For comparing percolation rates of water through soils of different character, the

author of this contribution from the Michigan Experiment Station proposes wetting the soil thoroughly in an excess of water, and then, the sample having been transferred to a Büchner funnel of standard dimensions, drawing off the water while the sample in the funnel is kept constantly covered with water by means of reduced pressure held constant, if necessary, by the use of a regulation manometer, the rate of collection of the water drawn through the soil being conveniently observed by collecting in a cylindrical graduate. It is noted that while the soil-water mixture must be stirred after it has been placed in the funnel, this stirring must be sufficient only to break up any lumps remaining after the soaking and not sufficient to disperse the soil.

A considerable number of data yielded by the method and apparatus described are presented in support of the claim of its accuracy for comparative purposes.

"All that can and should be expected from this laboratory percolation method is to show the comparative permeability of the different kinds of soils under a comparative or similar set of conditions, or to show reliably the permeability of any one soil under different sets of conditions or treatments, but it should not be expected to show the permanent or absolute permeability of soils, because there is no permanent or absolute permeability of soils either under laboratory or field conditions."

244. A Holder for Soil Sample Bags. By N. McKaig, jun. (*Soil Sci.*, xxix., 3, 1930, p. 191. Abstr. from *Exp. Sta. Rec.*, lxiii., 5, 1930, p. 418.) "The holder consists of a $1\frac{1}{4}$ inch iron rod, the upper end of which is bent in the form of a circle. For the standard canvas bag used by the Bureau of Chemistry and Soils, U.S. Dpt. of Agriculture, a circle with an inside diameter of $3\frac{1}{2}$ inches is satisfactory. Four small holes are drilled in the rod at equal intervals, and in each is fastened a nail or $\frac{1}{8}$ by 1 inch bolt, sharpened and bent to form a curved hook whose point extends about $\frac{1}{2}$ inch toward the centre and about $\frac{1}{2}$ inch above the top of the circle." The lower end of the straight part of the rod is pointed for pushing into the ground. The device is represented by a drawing.

245. Soil Reaction and pH Values. By O. F. Jensen. (*The Amer. Fertilizer*, Philadelphia, 1930, vol. lxxii., No. 7, p. 19. Abstr. from *Int. Rev. Agr.*, xxi., 7, 1930, p. 243.) A study of soil reaction, its application to certain crops, and the correction of soil acidity.

246. The Mechanical Analysis of Soils without Acid Pretreatment. By B. M. Olmstead and L. T. Alexander. (*Soil. Res.*, Supplements to the Proc. of the Internat. Soc. of Soil Science, Berlin, 1930, vol. ii., 1, p. 68. Abstr. from *Int. Rev. Agr.*, xxi., 7, 1930, p. 243.) The method used at the Bureau of Chemistry and Soils in the United States avoids the use of hydrochloric acid, which has the drawback of dissolving silica and sesquioxides as well as lime. The soil is treated with hydrogen peroxide (H_2O_2) to eliminate organic humic matter, then with sodium oxalate as a dispersing agent. The writers hold that this method is more rapid and accurate than the international method.

247. Ueber die Herstellung von Humusextrakten mit Neutralen Mitteln. By K. Simon. (*Zeitschrift für Pflanzenernährung, Düngung und Bodenkunde*, Berlin, 1929, xiv., 4-5, p. 252. Abstr. from *Int. Rev. Agr.*, xxi., 8, 1930, p. 285.) A study of the solvents for the extraction of humus from soils for analytical purposes. To avoid the known drawbacks of solutions of caustic alkalis and alkaline carbonates the author recommends the use of alkaline fluorides or oxalates, which give very good results. The following salts, although less good, may also be used: sodium acetate, sodio-potassic tartrate, sodium phosphate, sodium sulphite, and borax. The action of the various salts is described and the analytical methods.

248. Occurrence of Nitrites in Soils. By G. S. Fraps and A. J. Sterges. (*Bull. No.* 412, Texas Agr. Exp. Stat., 1930.) Deals with the subject under the following headings: Nitrites in soils without additions of nitrogenous materials; nitrification capacity as measured by nitric nitrogen alone, and by nitric and nitrous nitrogen combined; effect of (*a*) time of incubation, (*b*) different amounts of water, (*c*) calcium and magnesium carbonates, (*d*) varying amounts of ammonium sulphate; persistence of nitrites in (*a*) cultures, (*b*) solution; nitrites in (*a*) field soils, (*b*) laboratory samples; nitrites and nitrates from urea; relation to soil type.

249. A Study of Methods for the Determination of the Available Potassium of Soils. By L. C. Wheeting. (*Soil. Sci.*, xxix., 1, 1930. Abstr. from *Int. Rep. Agr.*, xxi., 8, 1930, p. 285.) The author considers that the Neubauer method of growth tests gives a better indication than all the other methods of the potash requirements of soils. As a solvent he prefers 10 per cent. ammonium chloride, which appears to give the most reliable results.

250. A Test for Water-Soluble Phosphorus: Studies on Water-Soluble Phosphorus in Field Soils. By C. H. Spurway. (*Agr. Exp. Sta. Mich. Sta. Coll. Agr., Tech. Bull. No.* 101, 1929. Abstr. from *Int. Rev. Agr.*, xxi., 8, 1930, p. 285.) The author describes his method and gives the results, which show how far the available phosphorus in the soil is influenced by various phosphatic fertilizers at different depths.

251. The Practical Sterilization by Heat of Small Quantities of Soil. By W. F. Bewley. (*Jour. of Min. of Agr.*, London, xxxvi., 7, 1929, p. 623. Abstr. from *Int. Rev. Agr.*, xxi., 8, 1930, p. 285.) A careful comparison of the two methods of sterilizing soil for pot or glasshouse culture, (1) direct steaming, (2) heating the dry soil by means of circulating hot gases from a fire below a brick container. The author is of opinion that the steam sterilization is preferable, since the other method produces much higher temperatures which modify the soil colloids and reduce their water-retaining capacity, and thus make the soil less suitable for pot culture.

252. Untersuchung über Bildung und Zersetzung von Humus im Stalldünger und im Boden. By W. Sauerlandt. (*Wissensch. Archiv. für Landwirtschaft, Abteilung A : Pflanzenbau*, Berlin, 1929. Abstr. from *Int. Rev. Agr.*, xxi., 8, 1930, p. 286.) Exhaustive studies of the formation and decomposition of humus in the soil and in stable manure.

253. Possibilities of Sulphur as a Soil Amendment. By G. S. Fraps. (*Bull. No.* 414, *Texas Agr. Exp. Stat.*, 1930.) Sulphur is an essential plant food, but is usually required in smaller amounts than nitrogen, phosphoric acid, or potash. Cotton, alfalfa, cabbage, onions, and turnips take up about 13 to 39 lb. of sulphur to the acre, while corn, rice, oats and wheat remove from 3 to 7 lb. The amount of sulphur brought down by rainfall in Texas averages 4 to 12 lb. per acre per annum, varying with different sections of the State. In pot experiments sulphur alone did not give as good results as complete fertilizers. It is not recommended as a fertilizer in Texas except in special cases on soils which run together under irrigation, or which contain black alkali. There is also a possibility that the use of highly concentrated commercial fertilizers containing little or no sulphur may result in a deficiency of sulphur in soils in some sections, especially for crops with high sulphur requirements such as cotton, alfalfa, onions, and cabbage.

254. Cotton Plant Fertilizer. By L. Jaumont. (*Chem. Abs.*, 24, 1930, p. 4114, from *Rev. Botan. Appl. Agr. Trop.*, 10, 1930, pp. 320-5. Abstr. from *Summ. of Curr. Lit.*, x., 20, 1930, p. 531.) Cotton especially requires nitrogen and potash for proper growth. In the right amount nitrogen, both organic and

inorganic, assures the development of a strong plant, while potash aids resistance to disease, formation of long resistant fibres, and good yields. The use of phosphates is advised to counterbalance the effect of too much nitrogen and to hasten the maturity of the crop. For the best results 320-400 kg. of a fertilizer containing 4 per cent. nitrogen, 10 per cent. phosphorus pentoxide, and 10 per cent. potassium oxide should be applied per acre.

255. Cotton Plant: Manuring with Activated Sludge Fertilizer. By E. B. Reynolds. (*Chem. Abs.*, 24, 1930, p. 4887, from *J. Amer. Soc. Agron.*, 22, 1930, p. 537. Abstr. from *Summ. of Curr. Lit.*, x., 24, 1931, p. 654.) On the average, treatment with activated sludge containing 4·6 per cent. nitrogen and 2 per cent. phosphorus pentoxide increased the yield of cotton 16·4 to 17 per cent., depending on the type of soil.

CULTIVATION, IRRIGATION, GINNING, USE OF SEED, ETC.

256. Some Modern Methods of Field Experiment and their Statistical Analysis. By D. D. Paterson. (*Bull. No.* 22, Dpt. of Agr., Iraq, 1930.) The author states that the object of the article is to describe as clearly and simply as possible one or two of the most widely accepted systems of experiments, and to explain the method of statistical analysis of results. No attempt has been made to prove either the principles involved or the formulæ used; these may be verified by reference to the literature cited.

257. The Arrangement of Field Experiments and the Statistical Reduction of the Results. By R. A. Fisher and J. Wishart. (*Tech. Communication No.* 10., Imp. Bur. of Soil Sci., Rothamsted, 1930. Price 1s. net.) This memorandum aims at explaining the principles underlying the field experimental technique recently elaborated at Rothamsted, and gives, with appropriate illustrations from actual experiments, the full arithmetical working involved in the statistical reduction of the data. The memorandum stresses two points of importance: (1) the desirability of uniformity of procedure, and (2) the necessity for a field technique which shall minimize experimental errors and at the same time provide for an estimate of these errors by valid statistical methods.

(The memorandum should be in the hands of everyone concerned with agricultural experiments.—Ed.)

258. Tractor Trials near Brakpan, July, 1930. (*Bull. No.* 91, Dpt. of Agr., Pretoria, S. Afr.) Gives records of the fuel consumed, the time taken and actual depth ploughed, and the quality of the work done in trials with the following tractors: Avance: " Borneo," " Solar "; Case: " C," " L "; Cletrac: " 20," " 30 "; Fiat; Fordson; Lanz: " Crawler," " Wheeled "; Mercedes-Benz.

259. Gyrator Cotton-Picker. (*Int. Cot. Bull.*, ix., 33, 1930, p. 70.) A new cotton-picking machine, named the " Gyrator-picker," which, it is stated, will reduce production costs to the point where 10 per cent. cotton will yield a profit, has been invented by Professor Olin Basquin and George R. Meyercord, a resident of Chicago. Altogether 14 machines are now actually in operation on farms in the Mississippi Delta region. The removal of the cotton from the boll and plant without damage to the staple is accomplished by providing a series of vertical steel drums, on the surface of which are several thousand reciprocal pickers with dull catchers which take hold of the cotton in the open boll as it is brought between the revolving drums, and is then pulled free from the boll. Immediately this action has taken place the pickers twirl with equal rapidity in the opposite direction, thus throwing the cotton free on to a conveyor, which takes it into a hopper attached to the machine. It is claimed for the machine that one acre of cotton may be picked in one hour regardless of the poundage of cotton to the acre.

260. Cotton Harvesting Machinery in Texas. (*Texas Sta. Rpt.*, 1929. Abstr. from *Exp. Sta. Rec.*, lxiii., **5**, 1930, p. 440.) Comparison of a commercial stripper, a modified finger type stripper, and single slot type stripper for harvesting cotton showed the commercial stripper to be the most efficient of the machines compared throughout the season, harvesting the equivalent of 560 lb. of picked cotton an hour in cotton yielding one-half bale per acre on upland soil. Cotton harvested by the machines graded lower than cotton picked by hand at the same time, largely because the sample contained small amounts of leaf and boll trash, which the cleaning equipment of the gin was unable to remove completely from the seed-cotton. Of the different plant characters studied in the 12 cotton varieties in the experiment the amount of vegetative growth, earliness, storm resistance, and size of boll seemed to be the more important. Rank-growing varieties maturing late and with small bolls lacking in storm resistance were more difficult to harvest, and the percentage of cotton wasted exceeded that in varieties without these characters.

261. Macarthy Gin. By Sir W. G. Armstrong Whitworth and Co., Ltd. (Newcastle), and B. M. Middleton. (E.P. 334,252 of May 31, 1929. Abstr. from *Summ. of Curr. Lit.*, x., **22**, 1930, p. 590.) In a double roller Macarthy gin in which the ginned cotton is delivered from the rollers on each side of a central discharge shoot for the seed, the seed is collected or discharged to a delivery trough so arranged that a substantially unobstructed passage is provided for the ginned cotton, whereby it may be removed from one side only of the machine. A screw or like conveyor is provided to feed the seed along the trough to a discharge shoot at one end of the machine. Alternatively the trough slopes to a central discharge.

[*Cf.* Abstr. **66**, p. 79, Vol. VI. of this Review.]

262. Cotton Seed Defibrating Apparatus. By A. G. Murdoch and British Cotton Seed Products, Ltd. (London). (E.P. 335,298 of July 10, 1929. Abstr. from *Summ. of Curr. Lit.*, x., **24**, 1931, p. 654.) In apparatus of the type comprising an annular chamber containing rotating defibrating elements, compressed air is admitted into the defibrating chamber from an independent supply provided with regulating valves.

263. Cotton Seed Sampling Machine. By G. S. Meloy. (*Oil and Fat. Ind.*, **7**, 1930, p. 337. Abstr. from *Summ. of Curr. Lit.*, x., **21**, 1930, p. 581.) The seed is fed by hand into a hopper through the bottom of which pass two narrow travelling belts. These draw out the sample of seed into a continuous ribbon, which is later split by a divider so that the two halves fall into separate receiving boxes. Divisions of 1,000 g. of seed have been made in this way, the two halves of which did not exceed 1·5 g. in error.

264. Cotton Seed: Analysis. By G. S. Jamieson and R. S. McKinney. (*Oil and Fat. Ind.*, **7**, 1930, pp. 291 and 315. Abstr. from *Summ. of Curr. Lit.*, x., **20**, 1930, p. 556.) Proposed standard methods for determining moisture, free fatty acids, oil, and ammonia in cotton seed are described.

PESTS, DISEASES, AND INJURIES, AND THEIR CONTROL.

265. Ein Fliegendes Laboratorium. (A Mobile Laboratory.) By G. O. Appel. (*Nachr. Bl. deuts. Pfl. Sch. Dienst.*, x., **8**, 1930, p. 67, Berlin. Abstr. from *Rev. App. Ent.*, xviii., Ser. A, **12**, 1930, p. 665.) A cabin is described that can be taken apart and loaded on the side-car of a motor-cycle, together with the necessary laboratory equipment.

266. The Water Balance of Plants as a Factor in their Resistance to Insect Pests. By E. P. Mumford and D. H. Hey. (Reprinted from *Nature*, vol. cxxv., No. 3150, p. 411. Abstr. from *Agr. J. of India*, xxv., 4, 1930, p. 330.) As a result of a review of the available evidence with regard to the effect of climatic and soil conditions on the distribution of the *Dysdercus* sp., the hypothesis was put forward by one of the authors (E. P. Mumford) in 1925-26 that a disturbed water content, from whatever cause, rendered the cotton plant more susceptible to the attack of sap-feeding insect pests, such as various species of thrips. In the autumn of 1926 several extensive tours were made into the cotton-growing regions of California, which included not only the well-known Sacramento, San Joaquin, and Imperial Valleys, but also the lesser-known Ferris, Coachella, Palo Verde, and Barde Valleys. At that time more than 160,000 acres of cotton were growing in California proper, an additional 130,000 acres occurring in Lower California. It was then found that thrips (*Heliothrips fasciatus*, Perg.) attack on Acala cotton invariably followed faulty irrigation practice. Thrips were never found in large numbers on plants receiving an optimum water supply. It seemed that plants suffering from water shortage were definitely more attractive to the attacking thrips. W. B. Camp, of the U.S. Bureau of Plant Industry, working in collaboration with the Department of Agriculture, has been carrying out a series of experiments on these lines for a number of years, and there is reason to believe that this hypothesis is supported and extended by the results of his researches. It also receives support from Bedford's observations on thrips (*Heliothrips indicus*, Bagnall) attack on Egyptian cotton in the Sudan (*Wellcome Trop. Res. Lab. Khartoum, Ent. Sec., Bull.* 18, 1921), though in some respects it would appear to be contradicted by Wardle's observations on *Thrips tabaci*, Lind., attack on cotton in a Manchester greenhouse (*Ann. App. Biol.*, xiv., 482, 1927. *Cf.* also MacGill, *ibid.*, xvi., 288, 1929.) It seems also that the nitrogen content of the sap is an important factor with regard to susceptibility to attack. This has been referred to by Davidson (*Ann. App. Biol.*, x., 35, 1923) and by Lees (*Ann. App. Biol.*, xiii., 506, 1926.)

267. Recent Advances in Entomology. By A. D. Imms. (J. and A. Churchill, London, 1931, price 12s. 6d. Abstr. from *Rev. App. Ent.*, xviii., Ser. A, 12, 1930, p. 690.) The enormous growth of entomological literature of recent years has rendered it impossible for the individual to keep in touch with all aspects of it, especially as these are themselves increasing both in numbers and complexity. This book should therefore be of great value, in that it summarizes in a compact form the more recent additions to knowledge on a number of selected subjects. The contents comprise two chapters devoted to morphology, one each to metamorphosis and palæontology, two to the sense organs and reflex behaviour, one to the fundamental aspect of coloration, four to some aspects of ecology and to its practical application, and two each to parasitism and biological control. A short but well-selected bibliography is appended to each.

268. Studies in Certain Factors affecting the Resistance of Plants to Insect Pests. By E. P. Mumford. (*Science*, 73, 1931, p. 49.) The author proposes the term "epiphylaxis" for external protective agencies, and "endophylaxis" for the internal protection afforded by biochemical qualities rendering the plant repellent or otherwise unattractive. As examples of the former he gives the hairiness of American cotton. The paper contains a good literature list.

269. Cotton Pests in Nigeria. By F. D. Golding. (*Trop. Agriculture*, viii., 2, 1931.) A general account of the more important pests, such as: Cotton stainers, Jassids, White flies, the Capsid bug *Helopeltis bergrothi*, Reut.; Bollworms: *Diparopsis castanea*, Hmps., *Earias insulana*, Boisd., *Earias biplaga*, Walk.,

Argyroploce leucotreta, Meyr.; Leaf roller and the Pentatomids: *Halydicoris scoruba*, Dall., *Nezara viridula*, L., and *Piezodorus pallescens*, Germ.

270. SOUTH AFRICA. *Cotton Pests.* (*Farming in S. Afr.*, v., **56**, 1930, p. 388.) *Sudan bollworm* (*Diparopsis castanea*).—Tests with light traps at Rustenburg realized a catch of 236 moths over four months, 78·8 per cent. being males, 11 per cent. gravid females, and 10·2 per cent. old females. An acetylene flare of 500 candle-power was used, and the experiment worked out at 6s. 3d. per moth, irrespective of sex. In an experiment designed to test the relative attractiveness of lights of different intensity it was found over a period of twenty-nine days that a 280 c.p. acetylene flare attracted 85 *D. castanea* moths against 23 in the case of a 70 c.p. flare, frequent interchanges of position of the two lamps being made to offset possible advantages in position. The flares also attracted individuals of other cotton-infesting Lepidoptera of the species *Heliothis obsoleta, Xanthodes graellsi, Earias* spp., and *Cosmophila auragoides*, but in much smaller numbers. Judging from the tests of the two seasons, the outlook for control of these pests by means of light traps, at least of the acetylene type, is not hopeful.

Heliothis obsoleta.—This pest is parasitized by a Braconid, *Microbracon brevicornis*, on which observations are being continued at Barberton. *H. obsoleta* caused serious injury throughout the season to cotton, maize, and marrows, but the parasite was never found to attack it except where it occurred on antirrhinum plants. Cold-storage experiments showed that the pupæ of *M. brevicornis* will survive at an average temperature of 44° F. for a period of fifty-one days. The field habits of the parasite and the difficulties attached to large-scale breeding would seem to minimize seriously the chances of its practical employment.

Syagrus rugifrons.—Following a request by several Zululand farmers' associations, an entomologist investigated the situation with regard to this pest, which has caused much injury in Zululand during the past few years. The situation was found to be particularly aggravated by the practice of ratooning, continuous cotton cropping, abandoned cotton fields, and wild host plants, such as *Cienfugosia hildebrandtii*, and possibly *Hibiscus calycinus*, and species of *Abutilon*. The main attack takes place soon after planting in spring, while a second attack may follow later, the chief damage throughout being root destruction by the larvæ. The adults are known to hibernate in cotton land under clods of earth. The control measures advocated are crop rotation, avoidance of ratooning, elimination of host plants, and spraying with lead arsenate.

271. INSECT PESTS OF COTTON IN SOUTH AFRICA. By T. J. Naudé. (*Pan-Afr. Agr. Vet. Conf., Pretoria*, 1929. *Papers Agr. Sect.*, pp. 255-256. Abstr. from *Rev. App. Ent.*, xviii., Ser. A, **10**, 1930, p. 527.) The cotton pests recorded from South Africa are *Diparopsis castanea*, Hmps., which has a number of wild food plants, this accounting largely for its wide distribution and the difficulty of its control; *Heliothis* (*Chloridea*) *obsoleta*, F., which has five generations a year and does not hibernate in the warmer areas, such as the north-eastern Transvaal; the Spiny bollworms, *Earias insulana*, Boisd., *E. biplaga*, Wlk., and *E. cupreoviridis*, Wlk., which cause relatively insignificant damage; jassid, *Empoasca facialis*, Jac., which is a serious pest in the more humid areas, particularly in wet seasons, and is also abundant on peas, cowpeas, and ground nuts; *Dysdercus fasciatus*, Sign., and *D. nigrofasciatus*, Stal., which are associated with boll rots, but are only occasionally of importance; and *Oxycarenus albidipennis*, Stal., which is very common, but does not cause extensive injury. Of the soil pests, considerable damage is occasionally done by cutworms, *Dasus* (*Gonocephalum*) *simplex*, F., weevils of the genera Protostrophus and Strophosomus, and the Eumolpids, *Syagrus rugifrons*, Baly., and *S. puncticollis*, Lef.

In the discussion that followed a number of speakers referred to the conditions

regarding cotton pests in other countries. W. Nowell agreed with the view that the prevalence of *Dysdercus* spp. and the boll rots they transmit is the most important factor limiting cotton cultivation in tropical countries. In St. Vincent the eradication of the alternative food-plants of the stainers, such as *Eriodendron* and *Malachra*, is an effective control measure; this, however, should be accompanied by proper disposal of cotton seed, as outbreaks have been traced to the use of cotton seed as manure and to seed left in ginneries. R. Jack said that no serious outbreaks of *Diparopsis castanea* occur in Southern Rhodesia, although it is very injurious in other parts of Southern Africa.

272. Cotton Pests and Diseases in Barbados. (*Rpt. on Dpt. of Sci. and Agr.*, Barbados, 1929-30, p. 112.) The control measures for Pink Bollworm, which have been in operation during the complete growing season 1929-30, appear entirely satisfactory. Other serious pests of cotton are the defoliators *Alabama argillacea* Hubn. and *Feltia* sp. and *Xylomerges* sp. The former is a well-known cotton pest, but the latter, which usually defoliate sweet potato fields, were found once in vast numbers defoliating cotton. The remedy at present advised in Barbados is dusting with Paris green and lime.

To prevent the introduction of pests and diseases all imported cotton seed was disinfected by means of a Simon's Heater erected on a barge, the bags of cotton seed being disinfected in the hold of the ship with Zyklon B. During the period under review 22,110 bags of cotton seed were disinfected and 26 ships fumigated.

273. Cotton Pests in Daghestan. By I. N. Filipjev. (In Russian.) (*Ann. Rpt. St. Inst. Exptl. Agr.*, 1928-29, Leningrad, 1930. Abstr. from *Rev. App. Ent.*, xviii., Ser. A, **11**, 1930, p. 606.) Studies on *Heliothis obsoleta*, F., which is the most important pest of cotton in Daghestan, showed that oviposition occurs in spring on cultivated leguminous plants and in June-July on maize. Cotton is infested from about the second half of July. Preliminary experiments showed that the females may be attracted to, and oviposit on, tassels of cotton yarn soaked in extracts from the maize silk.

274. Studies of Insect Pests. (*42nd Ann. Rpt. S. Carolina Exp. Sta.*, 1928-29. Abstr. from *Rev. App. Ent.*, xviii., Ser. A, **11**, 1930, p. 582.) The injury done to cotton seedlings by *Thrips tabaci*, Lind., is very difficult to compute, but undoubtedly stunting and malformation of the plants occur, and lateral growth frequently starts from the buds in the axils of the cotyledon leaves. *Frankliniella fusca*, Hinds, also attacks cotton seedlings, though it is usually a pest of tobacco; both these thrips were controlled by sprays of nicotine and soap, nicotine and oil emulsions, or pyrethrum and soap.

275. The Pink Cotton Bollworm (*Gelechia gossypiella*) in Belgian Congo. By C. Seydel. (*Pan-Afr. Agr. Vet. Conf., Pretoria*, 1929. *Papers Agr. Sect.*, pp. 257-8. Abstr. from *Rev. App. Ent.*, xviii., Ser. A, **10**, 1930, p. 528.) The inefficiency of the measures used in the Belgian Congo to prevent the introduction or spread of *Platyedra* (*Gelechia*) *gossypiella*, Saund. (pink bollworm), is pointed out. Disinfection of seed by heat is unsatisfactory if entrusted to native labour, and the possibility of treating it by fumigation or by immersion in insecticides that would not affect germination should be considered.

276. A Study of Hibernation of the Corn Earworm in Virginia. By W. J. Phillips and G. W. Barber. (*Tech. Bull. Virginia Agr. Exp. Sta.*, No. 40, Blacksburg, Va., 1929. (Recd., 1930.) Abstr. from *Rev. App. Ent.*, xviii., Ser. A, **11**, 1930, p. 583.) This paper gives the results of experimental work and field observations on the hibernation of *Heliothis obsoleta*, F. (corn earworm or cotton bollworm), in Central Virginia from 1921 to 1928 inclusive. In summer the period from the time larvæ entered the soil until moths emerged ranged from

14·6 to 19·9 days. Larvæ entering the soil construct a burrow for the escape of the adults. The pupæ rest in a cell or enlarged space at the bottom of the burrow at a depth of ½ to 9 inches, depending on the type of soil and the season. Larvæ construct comparatively shallow burrows in the summer, but go much deeper in the autumn. About 43 per cent. of larvæ that entered the soil failed to pupate, and mortality of the hibernating pupæ was very high, averaging 95 per cent. The minimum hibernation period was 248 days, the maximum 367. Hibernating individuals may be present in the soil throughout the year. They hibernate more successfully in soils rich in clay than in lighter soils, except in soils very rich in humus. The kind and quantity of vegetation has a direct bearing on their survival. Roots often fill the emergence burrows or close their exits and prevent the escape of moths. Moles are the most important predaceous enemies of hibernating pupæ in the area studied; when they gained access to cages they destroyed as many as 92 per cent. Earthworms frequently fill the emergence burrows with castings and thus may prevent the emergence of the moths. Experiments have shown that *H. obsoleta* hibernates more successfully in a dry condition than under the normal precipitation of natural field conditions. A larger percentage of individuals hibernated successfully in the field cages during a season of very light precipitation. Field experiments indicated that excessive rains during the normal emergence period delayed emergence. Individuals emerged from dry hibernation considerably later than from hibernation under natural conditions. Shade was found to delay emergence and to limit the percentage that hibernates successfully.

277. Dusting Sulphur for the Control of Cotton-Leaf Bugs. By A. L. Hamner. (*Circ. No.* 86, Mississippi Agr. Exp. Sta., 1929.) Dusting cotton with a 300-mesh sulphur for the control of the tarnished plant bug, cotton hopper, and other insects causing similar damage gave an average increase of 275 lb. of seed cotton per acre. The increase on the different plats was evidently affected more by the ability of the plants to hold the forms set than by the intervals at which the dust was applied. Plats dusted the second time on the fifth day had the lowest percentage of productive plants, while those dusted the second time on the tenth day had the highest. Both the production and the percentage of productive plants indicate that the dust applied at a ten-day interval was as effective as that applied at a five-day interval.

278. The Brown Cutworm (*Euxoa radians*, Guen.). By G. A. Currie. (*Queensland Agr. J.*, xxxiv., 4, 1930, pp. 383 and 488.) In Sections III. and IV., the natural enemies of the brown cutworm—parasites, diseases, and predators—and the measures of control, are considered.

[*Cf.* Abstract 99, p. 65, Vol. VIII.]

279. The Biology of Thysanoptera with Reference to the Cotton Plant. VI. The Relation between the Degree of Infestation and the Date of Planting. By E. I. MacGill. (Reprinted from *Ann. App. Biol.*, xvii., 4, 1930.) Investigations were made of the degree of infestation of plants grown in light soil and in clay soil sown at different dates. The plants sown late in the season in light soil were more affected by the thrips, the infestation being relatively high almost from the germination of the plant, and causing death before the flowering stage was reached. On the blocks of plants in light soil sown earlier in the year the infestation was relatively low for a considerable period, and although, at the end of the season, the thrips became very numerous on these plants, it was not until after the bolls had been formed, and in this case the practical damage was small.

The plants sown in clay soil at different dates did not show such a marked difference in the degree of infestation, and all were less infested by the insects

than the corresponding blocks of plants in light soil. This corroborates the findings of previous experiments, namely, that plants grown in light soil are found to be more heavily infested by *T. tabaci* than plants grown under similar conditions in clay soil.

[*Cf.* Abstracts **103**, Vol. V., **618**, Vol. VI., **360**, Vol. VII., of this Review.]

280. NOTIZIE SULL' ARRICCIAMENTO DEL COTONE NELLA SOMALIA ITALIANA. (Notes on Leaf-Crinkling in Cotton in Italian Somaliland.) By G. Paoli. (*Rassegna econ. Colonie, No.* 3-4, 1930, Rome. Abstr. from *Rev. App. Ent.*, xviii., Ser. A, **12**, 1930, p. 659.) Crinkling of the leaves of cotton has been observed in various parts of Africa, but appears to occur only in the presence of the jassid, *Empoasca facialis*, Jac., and to be due to the effect of the insect's saliva and not to the transmission of a virus capable of development after inoculation. The symptoms decrease at the end of the season, and this has usually been thought to be due to the advent of the rains; as regards Italian Somaliland, however, the author attributes it to a Mymarid parasite, *Anagrus* (*scassellatii*, Paoli), that attacks the eggs of *E. facialis*. The resistance of certain varieties of cotton to jassid attack is discussed.

281. UN MIMARIDE NUOVO DELLA SOMALIS (*Anagrus scassellatii*, Paoli). (A new Mymarid from Somaliland.) By G. Paoli. (*Mem. Soc. Ent. Ital.*, ix., 1930, p. 228, Genoa. Abstr. from *Rev. App. Ent.*, xviii., Ser. A, **12**, 1930, p. 659.) *Anagrus scassellatii*, sp.n., described from Italian Somaliland, parasitizes the eggs of the jassids, *Empoasca facialis*, Jac., on cotton and castor-oil plant (*Ricinus communis*), and *E. dolichi*, Paoli (MS.), on *Dolichos* (see preceding paper).

282. SCHISTOCERCA IN CENTRAL ASIA. By E. Yatzentkovskii. (In Russian.) (*Ann. St. Inst. Exptl. Agron.*, vii., **6**, p. 692, Leningrad, 1929. Abstr. from *Rev. App. Ent.*, xviii., Ser. A, **11**, 1930, p. 610.) *Schistocerca gregaria*, Forsk., invaded Central Asia in the summer of 1929. It was found to be subject to both pure bacterial and mixed bacterial-fungous infections, which may have played a part in the extermination of the invading swarms. Some 400 samples of bacteria and fungi were collected and are now being studied.

283. A CONTRIBUTION TO THE BIOLOGY OF THE BROWN SWARM LOCUST (*Locustana pardalina*, WLK.) AND ITS NATURAL ENEMIES. By J. T. Potgieter. (*Pan-Afr. Agr. Vet. Conf., Pretoria*, 1929. *Papers Agr. Sect.*, pp. 265-308. Abstr. from *Rev. App. Ent.*, xviii., Ser. A, **10**, 1930, p. 529.) The annual expenditure by the Government of South Africa on *Locustana pardalina*, Wlk., during 1920-29, which reached a total for the nine years of £1,183,466, is tabulated, and the history of locust research in that country is discussed. The two injurious species of migratory locusts in South Africa are *Nomadacris septemfasciata*, Serv. (red locust), which usually occurs in the east, and *L. pardalina*, which is more prevalent in the west. An account is given of the results obtained by the author in experiments on various aspects of the biology of *L. pardalina*. Valuable assistance in control is rendered by various migratory birds, including storks (*Ciconia* and *Abdimia*), the small locust bird (*Glareola melanoptera*), a kestrel (*Tinnunculus naumanni*), and a kite (*Milvus aegyptius*). Of the South African birds, the wattled starling (*Creatophora carunculatus*) destroys the hoppers, and two species of *Tinnunculus* often follow flying swarms in great numbers. Pheasants and guinea-fowl destroy the hoppers and eggs, and veldt rodents and baboons readily feed on the latter. In March and April, 1925, large numbers of locusts were destroyed by a fungus, *Empusa grylli*. An account is given of some observations and experiments on the biology of four Dipterous parasites of this locust—viz., the Nemestrinid, *Symmictus costatus*, Lw.; the Bombyliid, *Systoechus albidus*, Lw.; the Muscid, *Stomatorrhina lunata*, F.; and the Calliphorid, *Wohlfahrtia euvittata*, Villen.

284. The Migratory Locust Problem in Africa. Advisability of Joint Action. By R. H. Williams. (*Pan-Afr. Agr. Vet. Conf., Pretoria*, 1929. *Papers Agr. Sect.*, pp. 263-64. Abstr. from *Rev. App. Ent.*, xviii., Ser. A, **10**, 1930, p. 529.) The desirability of forming a Pan-African Locust Bureau, in order to obtain maximum efficiency in locust control, is urged. Its functions would be to receive, record, and co-ordinate information on various aspects of the locust problem, draw up proposals for combined action, and undertake propaganda work in connection with locust campaigns. The organization should be maintained for at least five years, and its work should be carried out under the control of a Committee composed of delegates from each Territory sharing in its cost.

285. Le Criquet Migrateur (*Locusta migratoria capito*, Sauss.) à Madagascar. By B. N. Zolotarevsky. (*Ann. Epiphyties*, xv., **4**, 1929, pp. 185-236. Abstr. from *Rev. App. Ent.*, xviii., Ser. A, **10**, 1930, p. 565.) The history of locust outbreaks in Madagascar is reviewed. The author gives tables demonstrating the differences between the African and Madagascar forms, and considers the latter a distinct subspecies, *Locusta migratoria capito*, Sauss. Descriptions and figures are given of the phases *solitaria, gregaria, transiens, dissocians,* and *congregans*, with detailed comparative accounts of the characteristic behaviour of each of these phases. The routes followed by the swarms in their general movement are discussed, and arguments are advanced against the theory that locusts invading Madagascar originate on the African continent.

286. Phoriden aus Eipaketen von *Locusta migratoria* in Daghestan. (Phorids bred from Egg-pods of *L. migratoria* in Daghestan.) By H. Schmitz. (*Natuurhist. Maandblad.*, xix., **6**, 1930, p. 67. Abstr. from *Rev. App. Ent.*, xviii., Ser. A, **11**, 1930, p. 606.) *Megaselia leucozona*, sp.n., *M. aspera*, sp.n., *M. parvula*, sp.n., are described from adults bred from egg-pods of *Locusta migratoria*, L., in Daghestan.

287. Cotton Diseases and Pests. (*Rpt. of Proc. of Pan-Afr. Agr. and Vet. Conf., Pretoria*, 1929.) A discussion by representatives of South Africa, Northern and Southern Rhodesia, and Egypt of the serious damage caused by cotton pests and diseases in those countries, and the measures of control advocated. In the course of the discussion Mr. Parnell spoke of the work carried out at Barberton in connection with the breeding of jassid-resistant cottons, and of the efforts by selection to obtain a strain to counteract bollworm damage. He also mentioned the work of Mr. King in Nyasaland and in Portuguese East Africa in connection with the control of bollworm by means of light traps.

288. Diseases of Cotton and Tobacco in South Africa. By E. S. Moore. (*Pan-Afr. Agr. and Vet. Conf., Pretoria*, 1929. *Papers of Agr. Section*, p. 252.) A brief statement of the position regarding the more serious diseases known to occur in the Union, and an indication of the most hopeful lines of control. The cotton diseases mentioned are: angular leafspot, internal boll disease, boll rot, damping-off disease, and cotton wilt.

289. Cotton Diseases in Florida. By M. N. Walker. (*Bull.* 214, Univ. of Flor. Agr. Exp. Sta., 1930.) A good general description of the following diseases of cotton occurring in Florida, and of the measures of control suggested: Wilt, root-knot, bacterial blight or angular leafspot, rust, soreshin, diplodia boll rot, anthracnose, boll rots, leaf spots. The author states that the chief means used in controlling cotton diseases really pertain to good culture, and are relatively easy to carry out. They are the use of good disease-free or resistant seed, proper fertilization and cultivation, and suitable rotations. The paper is well illustrated, and contains at the end directions for delinting cotton seed written by A. F. Camp.

290. Plant Disease Investigations at the Texas Station. (*Texas Sta. Rpt.*, 1929. Abstr. from *Exp. Sta. Rec.*, lxiii., 5, 1930, p. 448.) Cotton root rot disease was specially studied. The disease may be carried over the winter by a resting stage (sclerotia), and a strand stage is also partially responsible for the over-wintering of the disease. The spore stage was not established as a means of spreading root rot; spores were germinated, but no infection was secured from them. Inoculation of healthy plants with soil taken from the immediate vicinity of diseased roots failed to produce infection, indicating that the soil itself is probably not a carrier of the fungus, except as it contains sclerotia. An examination of the roots of plants *in situ* gave no evidence that root rot spreads except by complete or proximate root contact. Strands apparently followed earthworm and other tunnels, thus giving an impression of soil penetration. In the loose soil of laboratory jars the root-rot fungus did not spread.

Sclerotium rolfsii was found associated with the wilting of seedling cotton plants, but was not found on mature plants, nor could such plants be inoculated.

291. Plant Pathology at the Florida Station. By R. W. Ruprecht *et al.* (*Flor. Sta. Rpt.*, 1929. Abstr. from *Exp. Sta. Rec.*, lxiii., 7, 1930, p. 643.) The finding of cotton rust on plats receiving a complete fertilizer led to the conclusion that lack of potash cannot be the sole factor predisposing cotton to this disease. A disease of cotton, *Fusarium moniliforme*, was found attacking both seedlings and bolls. Evidence was secured that potash, even in large quantities, does not markedly reduce the incidence of wilt on susceptible varieties.

292. Notes Phytopathologiques sur les Cotonniers au Soudan Français. By J. Szymanek. (*Rev. de Bot. Appliquée*, x., 105, 1930, p. 294. Abstr. from *Rev. App. Mycol.*, ix., 12, 1930, p. 778.) In the French Sudan, anthracnose (*Glomerella gossypii*) of cotton leaves, stems, and bolls becomes common about midway through the vegetative period. Angular leaf spot (*Bacterium malvacearum*) also occurs, but is rather less prevalent. In the vicinity of Ségou Asiatic cottons are much more resistant to these diseases than are American varieties, but in the less arid region to the south of the River Bari the Asiatic variety Karangani was severely affected. Wilt (*Fusariun vasinfectum*) caused heavy losses. The attacks are intermittent and their intensity varies with the locality. Near Ségou the disease becomes most intense when the rains are most frequent and abundant—*i.e.*, when the soil remains damp and the temperature favours the development of the fungus.

293. Potash in Relation to Cotton Wilt. By M. N. Walker. (*Bull.* 213, Univ. of Flor. Agr. Exp. Sta., 1930.) The following conclusions may be drawn from the results of the three tests reported by the author of the effect of potash on the control of cotton wilt: Although no plots were planted without potash, it would appear that potash is of little direct value in reducing the infection of cotton by *Fusarium vasinfectum*; and, in the case of a susceptible variety of cotton on heavily infested soil, it is not possible to increase the yield of the uninfected plants by special fertilization enough to counteract the high mortality that occurs. Where a field is not extremely heavily infested with the wilt organism it is no doubt possible to increase yields sufficiently to offset to some degree the injuries resulting from wilt, but this increase in yield, however, will result from the use of increased applications of a complete fertilizer, and not from the action of any particular constituent of the fertilizer. The degree to which this latter means of combating wilt is successful will depend on the natural fertility of the soil, the susceptibility of the variety of cotton grown, the degree to which the soil is infested, and the injuries resulting from other causes.

294. Maintenance of Moisture Equilibrium and Nutrition of Plants at and below the Wilting Percentage. By J. F. Breazeale. (*Arizona Sta.*

Tech. Bull., 29, 1930, p. 137. Abstr. from *Exp. Sta. Rec.*, lxiii., **6**, 1930, p. 511.) Continuing earlier work (*cf.* Abstract **636**, Vol. VII.), it is concluded that "the contact of moisture film is continuous from the soil to the growing plant at all soil moisture percentages above the wilting percentage"; and, further, that "a plant may absorb moisture from any soil horizon where water is available—for example, a subsoil—and transport this moisture to another horizon where moisture is scarce —for example, the surface soil. It may there exude this water, dissolve, and absorb certain amounts of nutrient materials."

It is considered also, on the basis of the detailed and varied experiments described, that "nutrient ions are probably taken up by the plant as electrical charges," the direct water contact between plant and soil permitting the entrance of ions "even after all soil water movement has ceased," so that, for example, "plants are able to draw nutrient materials from a soil which is maintained at the wilting percentage."

Available soil moisture is defined as "that water which is held by the soil with a force of less than the suction force of the plant, or a force of less than about five atmospheres." The wilting percentage of a soil "is assumed to be the state of equilibrium which exists between the suction force of the plant and the adhesive forces of the soil," and was found to vary with the type of plant, the root distribution, root length, the transpiration rate, and other factors.

295. Recent Studies on Phymatotrichum Root Rot. By J. J. Taubenhaus and W. N. Ezekiel. (*Amer. J. of Bot.*, xvii., **6**, 1930, p. 554. Abstr. from *Rev. App. Mycol.*, ix., **11**, 1930, p. 716.) Some outstanding features of the recent investigations on cotton root rot (*Phymatotrichum omnivorum*) in Texas are summarized and discussed. The disease has been found to attack at least 274 species of cultivated plants, including a number of economic importance, while it also occurs on some 244 other species. The aggregate annual loss from root rot in Texas is estimated at about $100,000,000. Cross-inoculation experiments between various hosts have given positive results.

The conidial (*Phymatotrichum*) stage of the fungus is found on the surface of the ground above infected roots, which may be decayed (as in the case of lucerne and jujube [*Zizyphus jujuba*]) to a depth of 8 feet, and has been microscopically shown to be connected with the vegetative *Ozonium* strands on the roots. The conidia germinate sparingly, and are not known to cause infection. Sclerotia and dormant hyphæ have been found in the soil, and cotton has been successfully inoculated with the former. Infection continues to spread on the roots during the winter, although there are no aerial symptoms of wilting.

Root rot was not transmitted by soil taken from active zones of diseased patches and inoculated into healthy plants. The disease further failed to attack plants grown in root-rot patches, but sifted to remove the roots, while it did occur in control containers filled with unsifted soil. Excavation studies of cotton plants and examination of the soil and roots showed no spread from these points of primary infection through the soil independently of the roots.

In laboratory tests the fungus developed profusely along the walls of glass vessels, but penetrated only a few centimetres into the soil. However, in containers loosely filled with Bell clay soil, *P. omnivorum* travelled at least 10 cm. through the soil to the glass wall.

Control measures, including clean culture, rotation with non-susceptible crops, the development of resistant varieties, and soil disinfection, are discussed.

296. The Inhibition of *Phytomonas malvaceara* in Culture Media containing Sugars. By I. M. Lewis. (*J. of Bact.*, xix., **6**, 1930, p. 423. Abstr. from *Rev. App. Mycol.*, ix., **11**, 1930, p. 715.) Fourteen strains of *Phytomonas malvaceara* (*Bacterium malvacearum*), freshly isolated from diseased cotton leaves

in Texas, failed to grow in culture media containing any of the sugars glucose, maltose, lactose, galactose, or levulose, with various nitrogenous compounds, when sterilized at 122° C. for fifteen minutes. This failure of growth was found to be due, not to incapacity to assimilate the various sugars, but to chemical changes caused by the high temperature of sterilization. It was not apparent at a concentration below 0·4 per cent. glucose in a solution containing also 0·1 per cent. peptone and 0·5 per cent. dibasic potassium phosphate, whereas above 0·6 per cent. no growth occurred. Similarly growth was inhibited by the presence in the medium of more than 0·2 per cent. phosphate. The inhibitory substance appears to be produced by specific reactions between glucose, a nitrogen compound, and phosphate in alkaline media under suitable temperature conditions.

297. POWDERY MILDEW OF COTTON. By N. G. Zaprometoff. (In Russian.) (*Cotton Industry*, Tashkent, 1930. Abstr. from *Rev. App. Mycol.*, ix., **11**, 1930, p. 715.) The author states that in August, 1929, powdery mildew was recorded for the first time in Russian Central Asia on a bush each of the Egyptian cotton variety Nubari and of the American Upland variety Triumph Navrotzky. Macroscopically the disease is very similar to the West Indian cotton mildew (*Ovulariopsis gossypii*) in St. Vincent, but the spots bear both conidia and perithecia, and the fungus is identified as a new form of *Leveillula* (*Oidiopsis*) *taurica*, which is named *L.* (*O.*) *taurica f. gossypii*. The conidia are formed singly on the conidiophores of the *Oidiopsis* type; they are hyaline, ellipsoid-cylindrical, and 43 to 50 by 13·2 μ in diameter. The perithecia are black, immersed in the mycelial mat covering the spots, globular, 157 to 175 μ in diameter, and are supplied on their lower surface with numerous hyaline, intertwining appendages up to 3 μ broad. The perithecia contain up to 14 asci, 76 to 80 by 23 to 33 μ, each with two ascospores measuring 25·5 to 29·7 by 16·5 μ.

The diseased cotton plants were growing in close proximity to weeds (*Zygophyllum fabago* and *Alhagi camelorum*) abundantly infected with *O. taurica*, a fact which suggests the possibility that the outbreak on cotton may either have been a casual sub-infection or may mark the first stage in the mutation of the parasite to adapt itself to a new host.

298. *Aspergillus* INFECTED COTTON: EFFECT OF SPINNING, SIZING, AND SCOURING ON. By V. A. Koutieichtchikof. (*Chim. et Ind.*, **24**, 1930, p. 945. Abstr. from *Summ. of Curr. Lit.*, xi., **1**, 1931, p. 16.) The author studied the effect of technical processes on *Aspergillus* fungi growing on cotton. The results show that mechanical processes such as spinning and weaving are not capable of freeing the material from the fungus, and that apart from unfavourable conditions—*e.g.*, high temperatures—it continues to develop on the cotton. Sizing does not destroy the fungus; the heating in the size and by the rollers is not sufficiently long to cause destruction, and the size itself forms a source of food for the mould and enables it to develop and spread. The low concentrations of acid and alkali usually employed in textile processes are not sufficient to kill the fungus, but boiling out with concentrated alkali under pressure for six hours destroys it completely.

299. A SIMPLE METHOD FOR THE GERMINATION OF OÖSPORES OF *Sclerospora graminicola*. By M. Hiura. (*Science*, N.S., lxxii., 1856, p. 95, 1930. Abstr. from *Rev. App. Mycol.*, ix., **12**, 1930, p. 774.) The oöspores of *Sclerospora graminicola* may be induced to germinate by placing a small piece of moist filter paper bearing minute quantities of oöspore powder on the surface of a layer of moistened cotton in the bottom of a Petri dish (care being taken that the contact between the paper and the cotton is only partial) and a second similar layer in the lid of the dish, the space between the two being about half the height of the dish. Small blocks of 2 per cent. agar may be substituted for the filter paper. The time

required for germination varies considerably at different temperatures, being 22 to 40 hours at 35° C., 24 to 45 at 30°, 30 to 48 at 25°, 42 to 60 at 20°, 3 to 4½ days at 15°, and 9 to 10 days at 10°.

GENERAL BOTANY, BREEDING, ETC.

300. Biometrical Relationships of Certain Characters in Upland Cotton. By G. N. Stroman. (*Jour. Amer. Soc. Agron.*, 22 (1930), No. 4, pp. 327-340.) Cotton varieties of the 1928 crop, including Russell Big Boll, Lightning Express, and five strains of Acala, were studied biometrically at the New Mexico Experiment Station. The characters, including weight of lint per boll, percentage of lint, number of 5-lock bolls, number of 4-lock bolls, number of vegetative branches, number of fruiting branches and height, gave a uniformly high multiple correlation upon yield for all varieties, running from 0·96 to 0·99. The correlation of seven of these characters upon number of 5-lock bolls ran from 0·94 to 0·99, upon weight per boll from 0·83 to 0·94, and upon number of 4-lock bolls from 0·82 to 0·97. The other multiple correlation cœfficients were not so high, and that upon percentage of lint was not significant. Evidently if the above-mentioned characters are taken into account in cotton breeding all of the characters associated closely with yield are included.

Yield was made up of number of bolls and weight per boll, and strong partial correlation coefficients were found. However, number of bolls was more closely associated with yield than weight of boll. Usually the varieties having the lowest weight per boll showed the poorest correlation of yield and weight per boll. Weight per boll and 5-lock bolls, as well as weight per boll and 4-lock bolls, were highly negatively correlated. The fact that both 4-lock and 5-lock bolls were correlated with weight of boll shows that number of bolls would be highly correlated with weight of boll. It appeared that a variety producing a high weight per boll and which can bear a large number of bolls should be the aim of the cotton breeder. The number of 5-lock bolls and number of 4-lock bolls were found to be correlated negatively and 5-lock bolls to be correlated to some extent with height. Fair positive partial correlations were obtained for number of fruiting branches and height. The partial correlation coefficients showed that the other characters studied were not correlated uniformly with each other.

301. Cotton Plants: Growth in Nutrient Solutions. By H. J. Harper and H. F. Murphy. (*Biol. Abs.*, 4, 1930, p. 1659 (from *Soil Sci.*, 26, 1928, p. 139). Abstr. from *Summ. of Curr. Lit.*, x., 24, 1931, p. 672.) Nine different nutrient solutions were studied in sand cultures. In three tests, Tottingham's solution produced the most satisfactory growth of cotton, although in one instance Shive's solution produced a slightly larger plant, but did not produce a normal development of squares and bolls. Pfeffer's solution produced a very satisfactory growth of cotton, and because of its lower salt concentration may be preferable under certain conditions to either Tottingham's or Shive's solutions. The utilization of rock phosphate by cotton was very poor when substituted for monopotassium phosphate in Pfeffer's solution, even though a considerable amount of insoluble phosphate was transferred to the sand culture when the solution was added. Since the absorption of iron by cotton grown in different nutrient solutions was not in proportion to the amount of iron present, an excessive amount of iron in Crone's solution does not explain the poor growth of cotton in that solution.

302. Development of Axillary Buds on Fruiting Branches of Pima and Upland Cotton. By C. J. King. (*Jour. of Agr. Res.*, vol. xl., No. 10, 1930, p. 697.) The axillary buds and branches on the fertile branches of Egyptian

cotton differ in morphology and behaviour from those on Upland cotton. In the Pima variety of Egyptian cotton rudimentary axillary branches begin development with the advent of minute triangular buds in the axil of each leaf, but ordinarily this development is cut short by the shedding or drying up of the buds, which maintain active growth for only a few days. In Upland varieties the axillary buds usually remain dormant, but they can be stimulated to growth at any time later in the season. In Arizona, axillary buds on Upland plants frequently begin development late in the season, especially on luxuriant plants that have shed excessively during the summer, and a second cycle of flowering may occur on the older fruiting branches. The axillary buds and bolls on both types of cotton are usually developed too late to contribute materially to the yield under Arizona conditions. Removal of the extra-axillary buds artificially by pinching off the new buds at frequent intervals resulted in more axillary buds being retained by the Pima plants, and many of them continued development to maturity. The removal of the extra-axillary buds on Upland plants stimulated many of the axillary buds into development, and a considerable number of them were retained by the plants until maturity. On the defruited Pima plants the axillary fruits that matured were located only on the internodes developed late in the season, while on the defruited Upland plants a greater part of them matured on the internodes developed earlier in the season. The artificial removal of the extra-axillary buds caused the plants to grow much taller and to produce longer and more numerous fruiting branches than normally. Both Pima and Upland plants that have been rendered almost sterile during the summer from effects of the crazy-top disorder may develop a large number of axillary fruits late in the season, those on the Upland plants being produced on both early and late developed internodes, while those of Pima form only on the late growth. The large numbers of very small buds that are shed naturally from the axillary positions on Egyptian cotton make it impracticable to use the method of collecting the shed squares or young bolls as a basis for estimating the "possible crop" or for assigning a proper ratio of shed buds and bolls as has been attempted by some investigators.

303. Hybrid Intensification of Plant Height in Cotton and the Relationship of Node Number and Internodal Length to the Phenomenon. (*42nd Ann. Rpt. Agr. Exp. Stat.*, Arkansas, 1930, p. 38.) A paper under the above title recently appeared in the *American Society of Agronomy*, vol. xxii., No. 9, pp. 787-801. The summary of the article is as follows: Intensification of plant height in the F_1 generation was very marked. Hybrid intensity was transmitted to both sesqui-hybrids and the F_2 generation, although the vigour waned somewhat from the conjugate generation to the back cross progeny and from the back cross generation to the F_2 population. The reversed swing in the back cross and the perjugate offspring may be attributed to Galtonian regression toward the average of the races, to a weakening of the height growth due to an upset in the normal function of some of the plants caused by the crossing of species, and probably to the segregating tendencies of height genes. However, a splitting for height would hardly be expected in offspring of parental plants so nearly equal in axis length.

The difference between the node numbers of the two parental strains was greater than the divergence in height. The curves for node number indicate distinct distributions, which is not the case for height of plant. The distributions for both parental strains lay within the same limits for height. The contrast of height allelomorphs was not sufficient for the detection of dominance activity. Many of the Upland plants were just as tall as the Pima plants and *vice versa.* One group could not overshadow the other. On the other hand, the contrast of the allelomorphs for node number was wide enough to get a measure of dominance.

Node number in the F_1 generation expressed full dominance and no intensification. The sesqui-hybrids and the F_2 generation gave more indication of segregation for node number than they did for plant height.

The paths of hereditary transmission of plant height, on the one hand, and that of node numbers, on the other, followed different courses. The axis length was much intensified in the F_1 generation and then tended to regress, with an increase in fluctuation to the average of the parental races. The node number assumed a position of full dominance in the F_1 generation. The adjustments of plant height and node number, although the two characters were following different routes of inheritance, were made by the flexibility of the internodal lengths of the plants. Hybrid intensity was due to an increase in the lengths of internodes and not to additions of joints or nodes plus internodes.

304. THE VALUE OF HYBRIDIZATION IN THE IMPROVEMENT OF CROPS. By R. B. Ekbote. (*Agr. Jour. of India*, xxv., **5**, 1930, p. 396.) In the section devoted to hybridization in cotton, the work of Leake at Cawnpore and Kottur at Dharwar Farm, Bombay, is briefly dealt with.

305. GROWTH FLUCTUATIONS DURING THE DEVELOPMENT OF SEED-COTTON. By W. L. Balls. (*Tech. and Sci. Serv.*, *Bull. No.* 101, Min. of Agr., Egypt, 1930.) The seed-cotton contained in cotton fruits (bolls) which opened for eighty consecutive days in a pure-line population grown on one small plot of soil in 1913 has been submitted to various measurements. The details for each character measured are presented in Table I.; the technique and probable errors in Table II. The total number of recorded measurements is about 37,500. These are all concentrated into Fig. 1, as 5-day means. The range of variation is shown to be closely similar for all characters measured except two, if due consideration be given to the number of dimensions involved in the measurement. The two exceptions to the above are Cell-Diameter and Breaking Stress of the secondary wall, which seem to be specific, and barely subject to fluctuation. The predominant environmental factor is root-immersion by rising water-table, accompanied by senescence effects. Synchronizing developmental stages by shifting the curves in time is shown to be useful in reading the evidence, but the data are too imperfect for detailed analysis by this means, and imperfections in a preliminary examination of the data are pointed out. Ginning out-turn is seen to depend primarily on number of hairs per seed. Hair-length presents some anomalies.

306. THE CHARACTERS OF THE COTTON BOLL IN RELATION TO ITS FLOWERING PERIOD AND POSITION ON THE PLANT. By S. N. Venkataramanan. (*Agr. J. of India*, xxv., **3**, 1930, p. 189.) The variation of the cotton boll in the Uppam plant is seen to be one of decline in character as the season advances. The feature is perceptible from branch to branch of the main stem, and from node to node likewise of each branch, whether sympodial or monopodial. Within each branch the regressions along nodes follow much on the same lines as that indicated by the flowering period. Besides the effect of the flowering period, the character of the boll is also fixed by the mode of branching. From flowers formed on the same date, the primary sympodia produce bolls of greater lint and seed weight than the secondary ones. Two factors are therefore concerned in the variation in Uppam cotton, viz., a decline from primary to secondary sympodia within the same flowering period, and a decline within each branch as this flowering period advances. The characters for which such decline has been noted are seed weight, lint weight, lint length and maturation period. In the number of ovules and seeds per lock, however, no effect is seen with differences in the flowering period. Spinning tests also show that earlier picked cotton is better than the late pickings from the same field of a pure strain, and is suitable for a higher standard of warp counts.

307. COTTON VARIETIES. By J. C. Overpeck and W. T. Conway. (*New Mexico Sta. Bull.*, 181, 1930, p. 13. Abstr. from *Exp. Sta. Rec.*, 63, 6, 1930, p. 527.) Varietal tests with cotton continued during the period 1924-29 showed Acala to excel in southern New Mexico, especially on soils of heavy texture. Lightning Express, Delfos, or similar cottons seemed to yield as much as or slightly more than Acala on sandy soils. The common strains of Acala did not seem to differ much, although Okra Leaf Acala apparently was not promising. Information on cultural irrigation, harvesting, and ginning practice is set forth briefly.

308. ASHMOUNI COTTON: ADVANTAGES. Missr Ltd., Alexandria. (*Text. Merc.*, 83, 1930, p. 448. Abstr. from *Summ. of Curr. Lit.*, x., 24, 1931, p. 656.) Compared with long-stapled American, Ashmouni is claimed to be less neppy and to require fewer twists per inch in spinning.

309. "FAROUKI" COTTON: CULTIVATION. (*Text. Weekly*, 6, 1930, p. 268. Abstr. from *Summ. of Curr. Lit.*, x., 23, 1930, p. 623.) Farouki cotton is grown in the Assiout district for Messrs. Reynolds and Gibson. In this, its third year of cultivation, the yield is about 10,000 bales, of which 6,000 have already been sold. It is about 1½d. per lb. cheaper than Sakel, but has the same uses. The staple is about 1⅜ inch, and the count spun is usually 74-80's.

310. COTTON RESEARCH IN NORTH CAROLINA. By C. B. Williams. (*N. Car. Sta. Rpt.*, 1929. Abstr. from *Exp. Sta. Rec.*, 63, 7, 1930, p. 634.) Inheritance studies involving the fuzzy tip character of cotton-seed gave indications that the factor S, which produces the smooth condition of the seed coat, is dominant to the factor s, which produces fuzz. The fuzzy tip factor T is dominant to complete fuzziness t, but is masked in the presence of S. The data suggested that the genetic constitution of the parents is for the smooth-seeded parent $SStt$ and for the fuzzy tip parent $ssTT$.

FIBRE, YARN, SPINNING, WEAVING, ETC.

311. COTTON OPENER FEED MECHANISM. By B. P. Dobson and K. H. Pickup (Bolton). (E.P. 333,939 of May 23, 1929. Abstr. from *J. of Text. Inst.*, xxi., 12, 1930, A 655.) The feed through a hopper feeder is controlled by the rate of feed in that a finger deflected by accumulated cotton operates mechanism which reduces the feed.

312. OPENING MACHINES. Br. Cot. Industry Res. Assoc. (Didsbury), T. Nuttall (Farnworth), and S. A. Shorter. (E.P. 337,171 of October 10, 1929. Abstr. from *Summ. of Curr. Lit.*, xi., 2, 1931, p. 29.) A hopper bale opener, hopper feeder, etc., having a vertical spiked lattice or a spiked wheel dividing it into two compartments, is provided with a duct leading from the front to the rear compartment whereby dust-laden air short circuits the lattice, etc., and assists in providing an adequate air supply for a combined cage or fibre-conveying means.

313. BALE OPENER. By Howard and Bullough, Ltd. (*Text. Weekly*, 6, 1930, p. 105. Abstr. from *Summ. of Curr. Lit.*, x., 22, 1930, p. 592.) The new type of bale opener is designed to deal with very hard and matted bales. The machine is based on the ordinary hopper principle with an evener or regulating mechanism and a stripper or beater. The elevating medium consists of two spiked cylinders instead of a spiked lattice. The cotton from the bales is thrown on to the feed lattice in the usual way, and carried into the hopper to be brought into contact with the first spiked cylinder, approximately 12 inches in diameter, rotating at 35 r.p.m., and having a surface speed of approximately 110 feet per minute. Co-operating with this small spiked cylinder and placed almost vertically above it is the second or larger cylinder, also spiked, approximately 27 inches in dia-

meter, rotating at 12 r.p.m., and about 81 feet per minute. The function of the smaller roller is to convey the cotton to the larger opening cylinder from the feed lattice and, at the same time, due to its higher surface rate, allow a full charge of cotton to be presented to the spikes of the larger cylinder. To permit of variations in conditions as demanded by different cottons, the smaller spiked roller is adjustable vertically. A machine of this type operating on very hard pressed cotton is attaining a production of 2,400 lb. per hour.

314. TEXTILE MICROSCOPY. By H. Ellis. (*Text. Rec.*, xlviii., **571**, p. 34, **572**, p. 22, **573**, 1930, p. 33.) Deals with the construction of the modern microscope, and the preparation and mounting of materials to be examined.

315. TEXTILE FIBRES: MICROSCOPY. By P. V. Perrott. (*Ind. Chemist.*, **6**, 1930, 325-6. Abstr. from *Summ. of Curr. Lit.*, x., **19**, 1930, p. 514.) Detailed instructions are given for the preparation of the specimen, staining, collodion embedding, beeswax embedding, cutting, and mounting. It has been found possible to complete eight or nine photographs, using the methods described, in ten working hours, plus time to dry photographic films and prints.

316. COTTON CELLULOSE: STRUCTURE AND PROPERTIES. By A. J. Hall. (*Cellulose*, i., 1930, pp. 176 and 194. Abstr. from *Summ. of Curr. Lit.*, x., **21**, 1930, p. 577.) The fine structure of the cotton hair is described, and the correlation between this fine structure and the properties of cotton cellulose discussed.

317. DIE SPINNEREI IN TECHNOLOGISCHER DARSTELLUNG. By E. Meister. (Berlin: J. Springer, 1930. Mk. 15.50. Abstr. from *Jour. of Text. Inst.*, xxi., **12**, 1930, p. 204.) Professor Meister's book is to be welcomed since, unlike previous works on the subject which dealt mostly with spinning machinery, it has to do with principles, and restricts the description of mechanisms to reasonable proportions. The chapters are arranged in the following order: Principles; properties and testing of yarns; special branches of spinning (*a*) cotton, (*b*) wool and related fibres, (*c*) bast fibres, (*d*) silk, (*e*) rayon, (*f*) asbestos. Sections that will be of particular value to English readers are those relating to high drafting and waste spinning for cotton, and mule spinning of worsted. The book is well furnished with clear diagrams.

318. FIBRE CROSS-SECTION PHOTOGRAPHS: PREPARATION. By P. V. Perrott. (*Ind. Chemist*, **6**, 1930, p. 365. Abstr. from *Summ. of Curr. Lit.*, x., **21**, 1930, p. 577.) The photography of the cross-sections of textile fibres, as prepared in the manner previously described, is carried out by using a projection method. This entails minimum apparatus and is also advantageous in that more than one person at a time can watch and observe the whole of the operations. A list is given of the apparatus required, and a quick and rapid method of procedure described.

319. FIBRE SECTION MOUNTING MEDIA. By J. M. Preston. (*J. Soc. Dyers and Col.*, **46**, 1930, p. 295. Abstr. from *Summ. of Curr. Lit.*, x., **21**, 1930, p. 577). The selection of suitable mountants for textile fibre sections is discussed. The chief factors which must be considered in making the selection are the relative refractive index and swelling action. Photographs are given showing cross-sections of the same viscose fibres mounted in collodion, glycerin jelly, Euparol, Canada balsam, and piperine. A satisfactory medium for acetate rayon is still to be produced, but glycerin jelly is the best of the common media.

320. OZONE AND COTTON FIBRES. (*Cellulose*, i., 1930, p. 161. [From *Text. Weekly*, **6**, 1930, p. 90.] Abstr. from *J. of Text. Inst.*, xxi., **12**, 1930, A 670.) It is shown that the apparent increase previously observed in the tensile strength of cotton under the influence of ozone is due to the action of the latter on the natural fats and waxes present in the cotton. In consequence the lubricating

effect is reduced and the increased friction results in an apparent increase in strength. Cotton freed from fat and wax shows a decrease in strength on treatment with ozone.

321. A NOTE ON THE DIFFERENTIATION OF HAIRS FROM THE EPIDERMIS OF COTTON SEEDS. By A. N. Gulati. (*Agr. Jour. of India*, xxv., 4, 1930, p. 313.) A reply to Dr. Harland's discussion of the paper by A. J. Turner on "Ginning Percentage and Lint Index of Cotton in Relation to the Number of Cotton Fibres per Seed."

[*Cf.* Abstracts **637**, p. 374, Vol. VI., and **265**, p. 164, Vol. VII.]

322. IN THE COTTON CHAMBER. "Essbee." (*Text. Rec.*, xlviii., 572, 1930, p. 29.) An account of the work of the cotton chamber of a spinning mill, dealing with the staff employed, the opening and mixing of the cotton, and the care of machinery.

323. LANCASHIRE COTTON MILL MACHINERY: AGE AND REPLACEMENT. By J. Ryan. (Reprint from *The Econ. J.*, Decr., 1930. Abstr. from *Summ. of Curr. Lit.*, x., 24, 1931, p. 669.) A survey of the position of the cotton spinning and weaving mills of Lancashire as regards equipment. An exhaustive investigation was made of just over 200 companies containing 2,000,000 spindles and 50,000 looms, and details are given in connection with the following: Opening machinery, carding engines, draw frames, combers, speed frames, spinning machinery, and finishing machinery. An attempt is also made to determine the rate at which the three main developments in the cotton trade—ring spinning, automatic looms, and high-speed winding—are taking place in Lancashire.

324. COTTON MIXINGS: BLENDING. By S. K. Khan. (*Indian Text. J.*, **40**, 1930, pp. 370, 461, 553, and 559. Abstr. from *Summ. of Curr. Lit.*, x., **24**, 1931, p. 655.) A general account of the purposes of blending cottons and of the factors to be considered.

325. OILED AND UNOILED COTTON: SPINNING TEST. By J. J. Brown. (*Melliand*, **2**, 1930, p. 46. Abstr. from *Summ. of Curr. Lit.*, x., **22**, 1930, p. 592.) Two lots of five bales each of 1⅛ inches strict middling Mississippi Peeler cotton were processed in two parallel lines of machinery, one lot being oiled, after leaving the vertical opener, with 0·3 per cent. of Breton Minerol E, using the high-pressure Breton Minerol Process equipment, whilst the other lot went through unoiled. In the blow room the visible waste was 1·296 per cent. for the oiled, and 1·183 per cent. for the unoiled cotton, the difference being due to the fact that more shale, leaf, and dirt were thrown out. The total waste was 4·442 per cent. for the oiled and 4·082 per cent. for the unoiled stock. In the cardroom the total waste was 10·14 per cent. for the oiled and 11·27 per cent. for the unoiled cotton. The invisible waste was 0·55 per cent. higher for the unoiled cotton. The comber waste was 13·48 per cent. for the oiled and 13·67 per cent. for the unoiled cotton. The amount of fly and dust was reduced at least 30 per cent. There was less overhead cleaning and operatives found that the machines on oiled cotton were easier to keep clean and ran better. The oiled cotton made better roving and there was a decrease of 54 per cent. in ends down on the intermediate frames, 58·6 per cent. on the fine frames, 42·8 per cent. on the spinning frames, and 38 per cent. on the doublers. The yarn made from unoiled cotton changed more readily, both in weight and breaking load, with atmospheric conditions than did that from oiled cotton. The breaking loads of the singles yarns were 39·68 lb. for the unoiled, and 37·83 lb. for the oiled cotton; the corresponding weights were 17·78 and 17·48 grains. No difference in the appearance of the singles yarns could be seen with the eye, but in the doubled yarns the oiled twofold had a slightly smoother appearance than the unoiled.

326. COTTON: OILING. (*Text. Mfr.*, **56**, 1930, p. 334. Abstr. from *Summ. of Curr. Lit.*, x., **21**, 1930, p. 567.) It has been claimed that oiling cotton reduces the total waste, particularly "invisible" waste, that the oiled material works better with fewer breakages, and that dust in the cardroom is substantially reduced. Various objections have been raised, and it has been suggested that the oil may have undesirable effects on the machinery, and may give rise to difficulties in dyeing and finishing. The amount of oil should not exceed about 6 oz. per 100 lb. of cotton. A suitable formula is olive oil 2 per cent., sulphonated castor oil 22 per cent., oleic acid 1·125 per cent., glycerin 3·25 per cent., soap 8·125 per cent., and mineral oil 82·25 per cent. Comparative spinning tests carried out in America on oiled and unoiled cotton are discussed. The figures show less waste for the oiled cotton. In the cases quoted, it is stated that breakages of ends were fewer for the oiled cotton in subsequent processes, and that the average breaking strength was higher for the oiled cotton.

327. COTTON MILLS: HUMIDIFICATION. (*Trans. Natl. Assoc. Cotton Mfrs.*, **127**, 1929, p. 229. Abstr. from *Summ. of Curr. Lit.*, x., **22**, 1930, p. 611.) A report of the findings of the Committee on Humidifying Practice set up by the N.A.C.M., given under the following headings: (1) Types of equipment. (2) Adequate evaporative capacity (not less than to maintain 85 per cent. R.H. at 84° F. for weaving, 55 per cent. R.H. at 90° to 70 per cent. at 87° for spinning and twisting; 70 per cent. at 87° for winding, warping, and the cloth room; 55 per cent. at 90° to 60 per cent. at 89° for carding, combing, and roving. (3) Value of high capacity. (4) Methods for determining capacity. (5) Recommendations for purchasers. (6) Proof of satisfactory performance.

328. HIGH-DRAFT SYSTEMS: EXPLANATION. By H. Meynell. (Pamphlet, 1930. Abstr. *J. of Text. Inst.*, xxi., **12**, 1930, A 652.) A short thesis on cotton spinning, with particular reference to high-drafting systems, designed to give the layman an explanation of the various processes through which the raw cotton is passed and manufactured into yarn.

329. THE NATURE OF THE DUST IN THE AIR OF COTTON CARD ROOMS. British Cotton Industry Research Association, 1930. (*J. of Text. Inst.*, xxi., **12**, 1930, T 595.) An investigation is described of the dust produced during carding in seventeen card rooms covering as wide a range of practical conditions as possible. It is shown that the dust consists mainly of very minute, almost invisible particles, and in addition a few large particles, chiefly fragments of fibre, which, although so obvious to the eye, may be numerically unimportant. The sampling of the air by Owen's jet extraction apparatus, the computation of the minute particles, and the expression of the results are described. As much as 1 per cent. of the dust might consist of fungus spores, especially those of the mildew organisms belonging to the *Aspergillus niger* group.

330. THE VICKERS-STAFFORD AUTOMATIC LOOM. (*Textilber.*, **11**, 1930, p. 170; from *Leipzig. Monats. Text.-Ind.*, **1**, 1930, p. 34. Abstr. from *J. of Text Inst.*, xxi., **12**, 1930, A 658.) Describes this American loom with automatic change of shuttle, together with three illustrations. Details are given of the drive with friction pulleys, the braking device for stopping the loom in the position in which the change of shuttle occurs, the cloth take-up motion with positive worm regulator, the positive warp let-off device, the picking motion, the design of the sley, the stock and bowl motion, the movement of the harness, the warp stop motion, and particularly the shuttle change with a shaft extending over the whole width of the loom upon which are disposed the cams controlling the change of shuttle and the drive.

331. AUTOMATIC LOOMS. (*Textilber.*, **11**, 1930, p. 173; from *Z. ges. Text.-Ind.*, 1929, 427. Abstr. from *J. of Text. Inst.*, xxi., **12**, 1930, A 658.) In the United

States about 60,000 Northrop looms with automatic change of shuttle are running, about 60 of which can be attended to simultaneously by a single operative, but of course that is only possible owing to the use of first-class material and working at a comparatively low speed. Besides, there are required a second attendant for filling fresh bobbins into the magazine, and also an overseer. German loom manufacturers also build automatic looms of excellent design. The *Sachsische Maschinenfabrik vorm. Rich. Hartmann A.-G.*, Chemnitz, construct an automatic loom, Model UN, of which two illustrations are given, which is fitted with self-lubricating bearings for the outer and inner tappet and crankshaft bearings, and Conrad bushes for automatically lubricating all parts that are subjected to most motion. An individual electric drive is provided with a motor placed at the rear beside the crankshaft. The Hartmann automatic looms are supplied in reed widths of from 95-230 cm. (about 37 inches to 7 feet 6 inches). Those wider than 175 cm. (70 inches) are fitted with a short crank connecting link for retarding the sley drive in its rear position while the shuttle passes through.

332. Automatic Cloth-Producing Machinery. By M. Proctor-Gregg. (*Text. Rec.*, xlviii., 572, 1930, p. 33.) Discusses the Northrop loom, and how its general use in Lancashire would affect the textile trade.

333. Circular Loom. By R. G. Clark. (*Text. World*, 78, 1930, p. 565. Abstr. from *J. of Text. Inst.*, xxi., 12, 1930, A 657.) A description of a loom which has been constructed to weave a tubing 3 or 4 inches wide at the rate of 250 picks per minute.

334. Cotton Weaving Sheds: Electric Drive. By R. H. Wilmot. (*Science Abs. B.*, 33, 1930, p. 547; from *Metrop. Vickers Gazette*, 12, 1930, pp. 85 and 102. Abstr. from *Summ. of Curr. Lit.*, x., 24, 1931, p. 660.) In the majority of cases where weaving sheds have been changed over from steam to electric drive, the latter has proved more economical and has given an increase in production. The author gives a detailed comparison between (1) group drive, in which one large electric motor is used for driving the main weaving shed lineshaft; (2) semi-group drive, in which each cross-shaft is driven from a motor; and (3) individual drive, in which each loom is driven from a small motor by belt, gear, or chain. The relative costs and gain in production for the three systems are given in a table. In view of its important advantages, the individual drive system, despite its higher cost, is being increasingly adopted both for converted and new sheds, but in cases where the initial cost has to be kept as low as possible, the semi-group system has proved an economical compromise.

335. Cotton Mill Costings System: Application. By F. Greenhalgh. (*Organization in the Cotton Trade*, pamphlet, 1930. Abstr. from *Summ. of Curr. Lit.*, x., 20, 1930, p. 565.) The author discusses the Cotton Trade Inquiry Report and present conditions in the industry, and advocates more efficient costing methods. An example is given that can be managed by one clerk for a mill of 100,000 spindles.

336. Cotton for Roads. (*Text. Rec.*, xlviii., 574, 1931, p. 39.) Further experiments in regard to the use of cotton in road construction are to be undertaken by the Ministry of Transport.

337. Cotton Highways. (*Int. Cot. Bull.*, ix., 33, 1930, p. 148.) Describes experiments in Texas and at Burnley in the use of heavy cotton fabric in highway construction.

338. Cotton Parachute Fabrics. By J. Black. (*Text. World*, 78, 1930, p. 410. Abstr. from *J. of Text. Inst.*, xxi., 12, 1930, A 659.) The requirements of parachute fabrics are discussed, and U.S. Army and Navy specifications are given.

One section of the trade affirms that silk is the only suitable material for this purpose, while another advocates the use of cotton. The points in favour of cotton are: Cotton will resist mildew and friction-burns better than silk; cotton will outwear silk and is much cheaper. With proper care and under fair climatic conditions the life of a silk parachute is about five years; there is reason to believe that cotton will exceed this. It is suggested that the ideal parachute fabric would be a cotton fabric having a weight of less than 1·5 oz. per sq. yd.; a bursting strength in excess of 150 lb. per sq. in., and a porosity of between 80 and 140 cu. ft. per minute per sq. ft. of cloth air flow, under ½ in. water pressure, at specified atmospheric conditions.

MISCELLANEOUS.

339. Lancashire Cotton Industry: Consolidation and Co-operation. By Sir K. D. Stewart. (*Text. Weekly*, **6**, 1930, p. 85. Abstr. from *Summ. of Curr. Lit.*, x., **22**, 1930, p. 622.) The functions and limitations of co-operative institutions are discussed, and the disadvantages of price-fixing policies are emphasized. Co-operative effort is most valuable when devoted to the gathering of information in the form of research and statistics, and for discussion and exchange of ideas. The results of co-operative efforts in the cotton industry have brought out a mass of facts and recommendations, but the co-operative institutions can only hand these on to their members for action, and cannot effectively act themselves. It is stated that for effective action consolidation along the lines of the Lancashire Cotton Corporation is required.

340. Cotton Industry: Rationalization. By J. A. Bowie. (*Text. Weekly*, **6**, 1930, p. 250. Abstr. from *Summ. of Curr. Lit.*, x., **24**, 1931, p. 685.) A report of a lecture emphasizing the need for (1) a static study of markets, comprising consumption in relation to composition, qualities, design, and prices, also analysis of sources of supply and investigation of competitors' products; (2) dynamic study, comprising seasonal, cyclical, and secular changes and so forth; and (3) a structural study of channels of distribution.

341. Cotton Industry: Economic Status. By E. B. Dietrich. (*Text. Mfr.*, **56**, 1930. Abstr. from *Summ. of Curr. Lit.*, xi., **2**, 1931, p. 50.) The situation is reviewed under the following headings: The trend away from localization, world cotton spindles and looms, the effect of the war, the method of growth, the demand for cotton textiles, cotton textile markets, tariff barriers, rationalization, and other types of control, hours, and wages.

342. Cotton Prices: Supplies and Consumption. By J. A. Todd. (*Trop. Agriculture*, vii., **12**, 1930, p. 326.) Discusses the general fall in prices, with particular reference to the action of the American and Egyptian Governments.

343. The Cotton Report: Its Value to Lancashire. By W. S. Ascoli. (Published by Williams and Norgate, Ltd., London, 1930. Price 1s.)

344. British Cotton Industry Research Association. (*Rpt. of 11th Ann. Gen. Meeting*, 1930.) The meeting was held in the new Experimental Workrooms of the Shirley Institute. The causes which led to the establishment of this new Department were explained by the Chairman, Mr. T. Nuttall, who also stressed the need for adequate financial support in order that the work of the Institute might not be delayed or curtailed. The Director of Research, Dr. Pickard, then gave an account of the year's work, and explained the uses of the different rooms in the new building and the disposition of the machinery.

345. Statistical Methods for Forecasting Raw Cotton Prices. By W. H. Slater. (*Text. Rec.*, xlviii., **574**, 1931, p. 34.) Deals with definitions of statis-

tics, importance of statistics, effect of supply upon price, world supply and demand, cotton price forecasting, financial factors affecting price, etc.

346. Report of the United Kingdom Trade Mission to the Union of South Africa, Southern Rhodesia, and Northern Rhodesia. (Published by H.M. Stat. Off., 1931. Price 1s. net.) A very interesting report, laying stress upon the factors that are regarded as handicapping British trade in these countries, and making recommendations for the development and increase of that trade.

347. Cotton Facts, Edition of 1930. The 55th edition of this useful little book, containing statistics of crops, receipts, stocks, exports, imports, visible supply, sales, prices, consumption, and manufacturing output of cotton and cotton products in the United States and other countries, also cotton mill statistics of the U.S., Europe, India, etc., and cotton acreage and yield statistics of each state and county in the South, and other matters.

348. Textile Recorder Year Book, 1931. The usual invaluable summary of facts bearing on the manufacturing side of the textile industry. New sections are included dealing with Rayon Sizing Practice and the Dyeing of Rayon, and a very thorough revision has been made of all the statistical data and tables of production, and many new figures are given.

349. A Story of a Hundred Years. Western Australia, 1829-1929. (Edited by Sir Hal Colebatch. Fred. Wm. Simpson, Govt. Printer, Perth, W.A., 1929.) We have received from the Agent-General, Western Australia, a copy of this book, which contains an excellent account, historical, geographical, and descriptive, of Western Australia, its flora and fauna, aborigines, mineral and agricultural resources, etc.

ADDENDA.

350. Reports Received from Experiment Stations 1929-30. (Published by the Empire Cotton Growing Corporation, price 2s. 6d., post free.) In the preface to this work attention has been called to the chief points of interest, such as (1) the great success of U. 4 and its progeny, which has led to the abandonment of several not unpromising strains; (2) the work that is being done with rotation of crops, a matter which, if properly attended to, should make cotton cultivation a much more permanent success; (3) the various cultivation experiments that are being carried out in connection with time of planting, ratooning, etc.; and (4) the work upon pests and diseases, especially bollworm and blackarm. The report is one that should be within reach of everyone concerned with the breeding or cultivation of cotton and similar crops.

351. International Control of Raw Materials. By B. B. Wallace and L. R. Edminster. (Washington: Brookings Inst. London: G. Allen and Unwin, 1931.) A detailed study of such things as Coffee Valorisation in Brazil, the Franco-German Potash Syndicate, etc. (*Cf.* Note at end of Mr. Brown's paper on p. 33 of this volume.)

PERSONAL NOTES

OFFICERS ON LEAVE.

When an officer of a colonial Department of Agriculture (or of the allied departments of Irrigation, Transport, etc.) comes "home" on leave, he usually brings with him much information that may be of considerable value to similar officers in other colonies, or to the officers of the Empire Cotton Growing Corporation, who have to collect, collate, and use all possible information relating to cotton. The Corporation would consequently much appreciate the courtesy if Directors of Agriculture and others would be so kind as to inform them, in advance if possible, of the names, probable addresses, and approximate dates of arrival in England of officers coming on leave. This would give the Corporation the opportunity of getting into touch with these officers themselves, and of giving the latter the opportunity of meeting with one another. A further courtesy would be conferred if the officers themselves, upon arrival, would call at, or inform, the offices of the Empire Cotton Growing Corporation, which are at the corner of Millbank and Wood Street (entrance by the first door in Wood Street), immediately opposite the offices of the Crown Agents for the Colonies.

At the date of writing, the following officers are on leave or will shortly be arriving in England from cotton-growing countries:

British Guiana	Mr. E. Beckett.
Ceylon	Mr. M. Park.
Iraq	Mr. E. R. Guest.
Kenya Colony	Mr. C. B. C. Handley.
,, ,, ...	Mr. C. O. Oates.
,, ,, ...	Mr. A. S. Walford.
Nigeria	Mr. A. J. Findlay.
Tanganyika Territory	Mr. A. H. Savile.
,, ,, ...	Mr. C. M. H. Sutherland.
Uganda	Mr. J. M. Wallace.
,, ...	Mr. H. R. Hosking.

The following officers of the Corporation's staff abroad are on leave or will shortly be arriving in this country:

Nigeria	Mr. G. Browne.
Nyasaland	Mr. H. C. Ducker.
South Africa	Mr. F. R. Parnell.
,, ,, ...	Mr. G. C. Ullyett.
Sudan	Mr. R. L. Knight.

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# THE EMPIRE COTTON GROWING REVIEW

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MARKETS

THE countries of Western Europe, of North America, and of many other parts of the world have progressed a long way from those early days when not only were markets strictly local, but the prices of the goods that were sold in them were strictly local also. For the earlier stages in the history of marketing we must, in general, go for examples to the more unsophisticated and more primitive countries, such as India or China, where even today one may find outlying districts that have progressed but little beyond the "grow-what-you-want-and-consume-what-you-grow" principle upon which the earliest agriculture was probably conducted. Even in the most primitive of such places, however, there is now usually some indication of marketing to be found, even if it be only very simple barter.

Before the development of means of transport from place to place, a man who perchance grew, let us say, a larger amount of some foodstuff than he actually needed for his own consumption, might exchange the excess with some neighbour who had grown too much cotton or too much of something else. Yet even in so simple a transaction as this there would be differences between different places. For example, the French or the German farmer, or the farmer of the north of England or the south of Scotland, who was in the habit of being indented upon for supplies by invaders, or even by the troops of his own country, would soon learn that it was a good thing to hide some of his crop for consumption after the soldiers had gone by, and would develop a more thrifty type of management than, say, the farmer of the south or east of England. Many local factors like this come into the problem, but the more general factors can none the less be followed, with their effects.

Simple barter would gradually die out with the coming in of money; the producer would sell his own surplus, and buy someone else's at the current market price, which would be determined simply by local scarcity or abundance. The result, however, would be much the same in the end. Even to this day this kind of thing goes

on in many tropical markets in out-of-the-way districts; we have ourselves found eggs varying in price from two to six for an anna in the course of a tour years ago into an outlying district of the Madras Presidency.

Many factors have been operative in changing this primitive state of affairs. Both the man who grew too much food and the man who grew too much fibre found by degrees that to do this regularly was in general a saving of labour. The man who can grow x pounds of cotton easily will in general be more easily able to grow $x+y$ pounds of cotton than x pounds of cotton and z pounds of some foodstuff, the values on the market of y and z being supposed equal. In some such way as this, probably, a certain amount of specialization would come into agriculture, and some, at any rate, of the growers would habitually grow more of some product or other than they themselves required, and would sell the overplus.

But so long as marketing was a really local matter, this specialization could not go very far, and the change that has gone on in many parts of the world is really very largely due to improvements in the carriage of goods from place to place. Markets have received the produce of larger and larger areas until specialization in agriculture has been able to reach the lengths that one may see in the tea country of Ceylon, the rubber country of Malaya, the wheat areas of Canada, the cotton districts of the U.S.A.

Many people do not realize how much progress in agricultural specialization depends upon progress in other things—nor, to look at it from another direction, how agricultural progress in its turn reacts upon other activities. Yet for the proper guidance of any of these activities it is essential to be able to realize as clearly as may be possible what is likely to be the effect of any alteration made in one or another.

Local exchange, such as has been described, would for a very long time be largely of the nature of barter, even though money might be employed. The price of any article would be a local one, the locally produced articles having their price determined by relative scarcity or abundance, the articles made elsewhere having it determined also by the cost of bringing them to market, which was often very great. One has only to think of a consignment of Indian silks arriving at Venice after running the risk of pirates in the Indian Ocean and the Mediterranean, and being transported across the Isthmus of Suez by land. It had then to pass safely through the Alps and down the Rhine or the Meuse through a land of castles whose owners took toll of travellers, to cross the Channel, and make

tiresome and often dangerous journeys in England. The astonishing thing is that the final price that was asked of the consumer was still possible of payment, even if only by the rich.

The local price of a local article would, on the other hand, be determined by (local) demand and (local) supply. In one place a pound of wheat might be worth a pound of butter; in another perhaps a quarter or half a pound, or even more than one pound. Such cheap and common products as wheat or butter would at first be local, but other products might be valuable enough to be worth carrying to market by hand or on the head for longer distances, determined largely by the value of the article per unit weight. One pound of peas might be worth carrying further than one pound of turnips. Examples of transport of this kind, without any facilities other than the method of human carriage, may still be seen in such instances of valuable products as guttapercha or rubber, though when it becomes worth while to cultivate the trees in conditions more favourable to easy transport, as in the case of rubber, the primitive method begins to disappear.

An early improvement in transport, though one which still left the markets fairly local, with prices locally determined, was the substitution of transport by pack animals for that upon the heads or backs of human beings. This involved the making of rather wider and better tracks than had previously been necessary, but roads, or definitely made tracks, were in general constructed later, and had perhaps more often a basis of military need than the requirements of agriculture.

For these early stages in marketing, little or no capital was needed, and in fact capital in the shape of money (credit was a later development) had hardly yet begun to exist in most agricultural countries, nor was there any taxable value from which the local government—often the same as the local landlord—could raise it. Early taxation was local, and was in kind—the cultivator giving to the landlord (as he still does in many places) or to the government (when the two were distinct), or to both, so much per cent. of what he grew. On this the landlord could live, but, until wider marketing was possible, he could probably sell little of his receipts. But if his receipt became greater than his actual needs, he might keep up a body of retainers to fight, and engage some of his neighbours to work for him by giving them in kind a little more than they had previously been able to grow for themselves. So long as money did not appear in the transactions, and so long as the country was frequently at war, this would not lead very far, but at a later period the landlord might gradually accumulate

a supply of capital in money, which might be employed in other ways than in agriculture, and which might be passed on to, and increased by, his descendants. Sooner or later some of this money, now available in a mobile form, would be certain to be used to construct real roads upon which wheeled vehicles might be driven, this at once opening up and enlarging the range of a market hitherto local, and enabling produce to be brought from greater distances. The little market towns all over England at distances of twelve to twenty miles apart, and usually in places where mills could be worked to grind the corn brought in, are a permanent reminder of this stage in the agricultural history of this country, placed as they are at such distances as were within reach of a cart from the neighbouring farms. With the opening of roads the range of prices would now depend upon larger supplies, and though still local, would not show such great variation as before.

This stage having been reached, further progress became more rapid, for all the conditions lent themselves to the more rapid accumulation of capital, without which nothing much in the way of progress is easily possible. Roads were continually improved and extended, railway transport came in, and export trade from a country, hitherto mainly confined to things grown near to the sea or to a big river, or to things of such value or necessity that it was worth while to carry them over great distances, became at last seriously possible, and in such countries as our own grew to an almost overwhelming extent.

Finally, it has come about that with the continual improvement in methods of transport, and with the continual growth of capital available for any form of enterprise that seems likely to be profitable, the market for all products of great importance to mankind in general (such as wheat, cotton, or tobacco) has become a world-wide affair, with prices fixed mainly by world supplies, and comparatively stable and uniform. Small local gluts or deficiencies make no difference to the price, as they do in a strictly local market. It is only a failure—or a glut—of a crop over a really large area that can do that, apart from the action of speculators. At the same time, as we have pointed out elsewhere (*E.C.G.R.*, Vol. IV., 1927, p. 1), there is still great risk of price troubles so long as any one country has too large a share in the total production, or has too few eggs in one basket.

The difficulty in the way of further economic expansion and of further levelling of prices is now the presence of international barriers, with the various hindrances that are there applied, and how these difficulties are to be surmounted will for some time to come be one of the most serious problems that lie before the statesmen of the

present time. It is very difficult for any one country to do much to help improve the price of its own goods without at the same time helping its rivals equally, as has been well illustrated of recent years by the Brazilian valorization of coffee, or our own scheme of rubber restriction, to say nothing of other schemes that are still in operation. Now that markets and other important features in agriculture have become international, international action would seem necessary in any schemes for regulation or improvement.

Incidentally, it may be noticed that agricultural progress has to a very great extent indeed been dependent upon progress in the improvement of transport and in the accumulation of capital, and this fact must never be allowed to escape from view.

COTTON GROWING IN IRAQ

BY

A. EASTWOOD.

THE outstanding feature of the agriculture of Iraq is that its prosperity depends upon irrigation. The rainfall, which averages 8 inches annually, is a useful asset, since in favourable years it enables cereals to be harvested from unirrigated areas, but it is far too erratic to be the basis of agricultural prosperity. The water for irrigation is provided by rivers of which it has been said that they " rise without warning; are always abrupt; carry five times the sediment of the Nile; have their annual flood in March, April, and May, too late for the winter, and too early for the summer crops," and " traverse a country where the temperature rises to 120 degrees in summer."

Although the degree of its productivity in the past appears to have been exaggerated, it is clear that in ancient times Iraq possessed systems of irrigation and agriculture that rivalled those of Egypt. The modern fame of Egyptian agriculture depends upon cotton, and in order to ascertain the prospects of a similar development of cotton-growing in Iraq, it is necessary to consider the reason why development has been delayed.

For four hundred years the Sultans of Turkey had complete control of the rivers Tigris and Euphrates from their sources to the Persian Gulf, but in the days of its ancient prosperity the rulers of Iraq were on the spot, and not in a distant city like Constantinople. To the Sultans of Turkey Iraq was a distant province inhabited by unruly and troublesome tribes.

Irrigation works on the scale necessary for the full utilization of the agricultural resources of Iraq demand the existence of a strong government with the wealth necessary for their construction, and the power necessary to enforce the just division of the waters and the protection of the farmers from lawless nomads. The advent of the Young Turks to power resulted in the completion of the Hindiyah Barrage, but the outbreak of war in 1914 prevented anything from being done with the other schemes that had been put forward by Sir William Willcocks for the development of Iraq.

On the conclusion of hostilities with the British Army in occupation of the country, it seemed likely that rapid development would

ensue, but the Arab rebellion that followed disillusioned those who thought Iraq to be peopled with peasants anxious for orderly government and the benefits that would follow from modern methods of irrigation control. The economic depression that ensued put out of the question any prospect in the immediate future of the rapid rate of development envisaged in the days of optimism that followed the conclusion of peace, and at the present time the Departments of Agriculture and Irrigation are mere shadows of the organizations that were set up by the British Army and taken over by the Civil Government. The steady reduction in the activities of these two departments has been caused by the necessity of keeping budget estimates within the sum available from the public revenue.

In 1917 Mr. Roger Thomas, then on the staff of the Agricultural Department of Madras, was lent to the Agricultural Directorate of Mesopotamia, which was part of the military organization in Iraq until the end of February, 1919, when it came under the control of the Civil Administration. He established an experimental station at Jadriyah, on the left bank of the Tigris a few miles below Baghdad, at which varietal and other tests with American and Egyptian types of cotton were carried out, until in 1921 the work was transferred to the newly opened Central Experimental Farm at Rustam, on the right bank of the Diyalah.

As a result of tests carried out during the three years 1918, 1919, and 1920, it was decided that of all the varieties of cotton under trial the one that possessed the best combination of characters was Webber 49. These characters were: (*a*) Relatively high yielding capacity; (*b*) relatively high-priced staple; (*c*) very large bolls, from which clean cotton is easily detached; (*d*) earliness of maturing; (*e*) relatively high resistance to drought as compared with Egyptian varieties. This cotton, however, had two disadvantages: (*a*) The brittleness of its branches; (*b*) its relatively low lint out-turn (ginning percentage).

The origin of the Webber 49 under test was a sample obtained by Professor Roberts, now Managing Director of the B.C.G.A. (Punjab), Ltd., while on a visit to America, where it had been bred by the Pedigreed Seed Co. of Hartsville, South Carolina. It was seen by Mr. Thomas growing at Lyallpur in the Punjab, and he brought with him to Iraq less than 2 lbs. of seed.

After propagation in 1918 and 1919 the amount of seed available was nearly 30 cwts., the bulk of which was allocated for a plantation of 80 acres at Tal Dair, lying between Baghdad and the Euphrates, and irrigated from the Yusufiyah Canal. Although a local sheikh

provided the land and labour, the supervision was entrusted to a trained Indian agriculturist and two Egyptian peasants, and the resultant yield of 1,250 lbs. of seed cotton per acre would probably have been much greater had not the outbreak of the Arab insurrection in July, 1920, made the neighbourhood too unhealthy for the Indian manager, and caused certain blocks to suffer from lack of irrigation.

The Department, on behalf of three large farmers, imported 10 tons of Sakellarides and 10 tons of Ashmuni, but the results obtained from these were very disappointing, although not all of the seed was planted. This lack of success must not be attributed solely to the insurrection. The choice of unsuitable land, and lack of experience in cultivation played their part, and the adverse result should not be taken to contradict the conclusion drawn by the Cotton Expert from his 1918 Varietal Test that "Mesopotamia can grow cotton of the Egyptian type, whose quality in respect to length, strength, and fineness equals and may even surpass that of the same average type grown in Egypt." Another conclusion that he recorded at the same time was that "the local conditions of climate and soil have been proved to be well suited to the cultivation of berseem (Egyptian clover)."

As it was now thought that the characteristics of Webber 49 as grown in Iraq were no longer identical with those of its parent grown in America by the Pedigreed Seed Co., it was decided to rename it "Mesopotamia White," which was subsequently contracted to "Mesowhite."

A ton of Webber 49 Strain 3 was obtained direct from the Pedigreed Seed Co. of Hartsville, but the 32 acres planted in 1921 at the new Central Experimental Farm yielded less than 9 tons of seed cotton. This did not mean that the new strain was less good than the old, but was due to the inferior nature of the soil, shortage of water consequent upon difficulties with the pumping plant, and the salinity of the water in summer in the lower reaches of the Diyalah. As a matter of fact, Webber 49 Strain 3 appeared to be an improvement on the original strain grown under the name "Mesowhite." It was therefore named "Hartsville," until it was realized that the name "Hartsville" had already been given by the Pedigreed Seed Co. to another of their varieties of cotton, and the general term "Mesowhite" has since been used to describe the product of both strains.

It is unfortunate that both Mesowhite and selections from it as grown in Iraq are definitely inferior both in length of staple and ginning percentage to the parent strains grown in America, according

to the data supplied in the catalogues of the Pedigreed Seed Co. Under favourable conditions the breeders claimed that Webber 49 Strain 3 gave a ginning percentage of $33\frac{1}{3}$ and a staple length full $1\frac{5}{16}$, whereas in Iraq a ginning percentage of 29 is not considered low and the staple seldom exceeds $1\frac{3}{16}$. The results obtained by farmers were disappointing, and the hopes engendered by the results at Tal Dair received a definite setback.

At the invitation of the Civil Administration the British Cotton Growing Association had established a ginnery at Baghdad in time to deal with the 1920 crop, and in 1922 they took over the distribution of selected seed to farmers. By charging a high price for the seed it was found that interest was increased, and the production increased from 60 to 300 bales. The following table shows the quantity of seed issued in tons, the resultant crop in bales of 400 lbs., and the average number of bales per ton of seed issued:

	Tons of Seed.	*Bales of 400 Lbs.*	*Bales per Ton of Seed.*
1920	—	60	—
1921	—	60	—
1922	35	300	9
1923	65	1,100	17
1924	135	2,400	18
1925	80	2,540	32
1926	118	3,500	30
1927	70	1,800	26
1928	114	5,200	46
1929	230	4,700	24
1930	171	3,300	19

The figures in the last column refer to bales per ton of seed issued, and not to bales per ton of seed planted.

The slump in cotton prices in 1926 had an important bearing on the reduced demand for seed in 1927, and an improvement in prices was reflected in the increased demand for seed in 1928. In that year the growing conditions were good and a record crop was harvested, with the result that in 1929 the seed issues were doubled. There was an increase of at least 50 per cent. in the area planted, but the total yield was 10 per cent. less than the previous year. This disappointing result was chiefly due to the invasion of the country by Najdi locusts during the planting season and the following two months. The direct damage was not great, but many farmers were

afraid that their labour would be wasted, and failed to thin the plants, and by the time the danger had passed it was too late for successful thinning. Other causes that contributed to the result were the abnormal level reached by the Tigris during the flood season, which necessitated the withdrawal of men from the farms for flood protection work; the inability to give the initial irrigation at the proper time because the pumps were submerged, and the inundation of plantations in isolated cases. The previous mild winter also had allowed insect pests, particularly the spotted bollworm, to hibernate successfully, and in consequence an early and intense attack resulted. The month of June was abnormally windless, and this encouraged both bollworm and aphis, and finally white fly—not previously noticed as a serious pest—contributed to the damage.

In spite of all these handicaps it will be observed that there is little difference between the yield in bales per ton of seed for 1929 and that for 1927, and the fact that 171 tons were issued in 1930 showed that the farmers were not seriously discouraged. Unfortunately, however, the Najdi locusts again appeared and destroyed the growing crop on many plantations. Many farmers were in consequence induced to curtail or abandon their planting programmes, and thinning was also neglected.

In striking contrast to the previous year, the summer water supply was abnormally low in both the Euphrates and the Tigris. This caused a short supply during August and September in the canals taking off from the Euphrates, and the cotton plantations suffered accordingly. The level in the Tigris fell to such an extent that in some cases pumping installations were cut off from the channel containing water by the formation of sand banks, and in others the wells collapsed, thus interrupting the water supply, and even when the wells remained intact many plantations suffered from water shortage until the pumps were moved so as to deal with water below the normal level. That the decrease in the total crop was due to localized and not general causes is shown by the fact that on some of the pump irrigated plantations the yield averaged a ton of seed cotton to the acre.

The most crushing blow, however, was the unprecedented slump in cotton prices, but the fact that over 70 tons of seed have been issued in 1931 is a striking proof that cotton-growing is now definitely and firmly established in the country.

A very interesting feature of agricultural development in Iraq is that there are now nearly 2,600 pumping installations, with a total horse-power of 75,000, located on farms nearly all of which are

suitable for cotton-growing, but although 90 per cent. of the crop is produced on farms irrigated by pumps, it is quite evident from the fact that the number of bales of cotton produced annually is less than the number of pumping engines rated at an average of 29 horse-power each, that the power employed on cotton irrigation is only a very small percentage of the total power available.

The ill-effects that arise from over-irrigation are less noticeable on lands irrigated by pumping than those irrigated by free flow, since they are usually better drained, and, owing to the cost of the water, it is used more sparingly. This probably accounts for the fact that about 90 per cent. of the crop is pump irrigated, but a further benefit arises from the fact that the crop can be irrigated when it appears to require water, whereas on a flow canal receiving an intermittent supply the time-table arranged may prove unsuitable and furthermore it may be necessary to cut off the supply entirely, in order that silt clearance may be carried out on the main canals.

During the past two years the number of pumping installations has increased by 450, the average horse-power of the oil engines being 36. In spite of the depression in agricultural circles 210 of these were installed during 1930. It is probable that most of the owners of these new installations were tempted to purchase them by the facilities that exist for paying by instalments for the plant, and also by the provisions of a law passed in 1926 with the object of encouraging pump irrigation. By this law the Government's share of the crop is remitted for two years in the case of land newly brought into cultivation by the use of pumps. The law applies not only to lands privately owned, but also to the Government lands known as Unalienated State Lands.

In many cases the fringe of these State lands had been cultivated with the aid of primitive water-lifting appliances by tribal Arabs, who considered that by long usage they had acquired sole rights of cultivation. The grant of permits to erect pumps on such lands led to a certain amount of friction when, as in most cases, the holder of the permit was a town-dwelling Iraqi with little or no agricultural knowledge and a stranger to the district.

The pump permit does not enable the holder to sell or mortgage the land to which it applies, and as many of these permit-holders have no capital, they have been compelled to borrow money at high rates of interest in order to meet the running expenses of the engine and to make advances to the peasant cultivators. In cases where the permit-holder has adequate resources he is usually able to come to an amicable arrangement with the tribal Arabs of the district, by

which they engage themselves to cultivate the land according to his instructions in return for a definite share of the crop, but when his lack of funds prevents him from carrying out his share of the bargain —especially as regards advances—to the extent that the peasants regard as their rights, they are disinclined to obey his instructions to plant crops which cannot be eaten or easily disposed of if stolen. These difficulties have given rise to a demand in certain quarters for the enactment of laws that will modify the right of the peasant to dispose of his labour as he thinks fit.

The year 1925 saw the formation of Diala Cotton Plantations, Ltd., with the special object of developing and cultivating, for cotton growing, 108,000 acres in the Diyalah area. As a result of negotiations following the discovery that the obligations entered into on both sides had been based on insufficient data, the original concession was relinquished and a fresh agreement of more modest dimensions was concluded, by which the Latafiyah tract of 60,000 acres on the left bank of the Euphrates was acquired by Diala Cotton Plantations, Ltd. The title of the company has been changed to Latafiyah Estates, Ltd., a canal has been constructed, and some 500 acres have been planted with cotton.

Although the new company is a purely commercial venture, it is hoped that the methods that are being employed will serve to demonstrate the advantages that result from the adoption of a systematic layout, energetic management, and the application of modern methods for the maintenance of fertility, the management of labour, and the cultivation of crops. The substitution of oil engines for animals as a source of power for lifting water has an important bearing on the impoverishment of the soil. It is probable that the fertility of ancient Iraq was due to the existence of low level canals from which the water had to be lifted by mechanical appliances worked by animal power. The barrage that enables the water to be run straight on to the land brings with it drainage problems, and reduces the supply of farm-yard manure for the maintenance of fertility. The same difficulty attends the increasing use of the farm tractor. The solution of the problem appears to lie in the growing of forage crops and the establishment of flocks of sheep.

Iraq is capable of supporting a much larger population than its present three million of inhabitants, and it is possible that some modification of the rigour of the summer climate might follow a large increase in the cultivated area. This might enable a finer type of cotton to be grown. At present even by careful selection

it is a difficult matter to maintain the quality of "Mesowhite." It was hoped that a cross between Mesowhite and Punjab 285F would prove more suitable, but so far neither this nor any other cross when tried out under ordinary conditions has proved superior to the Mesowhite parent.

In one respect Iraq is fortunate: the pink bollworm is not present. It must certainly have been introduced, but it simply cannot stand the intense heat to which it would be subjected in summer. The spotted bollworm is encouraged by mild winters, over-watering, neglect of thinning, and failure to prohibit ratooning. It has sometimes been blamed for poor crops, whereas the true cause was salty soil. The progressive farmer does not suffer unduly from this pest, but sometimes sufferers complain that the seed supplied is responsible. White fly and thrips have been found to cause a certain amount of damage, but the main fear of the farmer is the locust. In the north the Moroccan locust is a formidable pest, and although in recent years active measures have been taken to suppress the annual outbreaks, the farmers are loth to take the risk of seeing their labour wasted, and refrain from planting on the scale that could easily be arranged were this danger removed. In southern and central Iraq the Najdi locust has become an annual visitant and does considerable damage.

In a country like Iraq the rate of agricultural progress depends to a great extent on the Department of Agriculture, and Iraq owes much to the energy and enthusiasm with which the staff have devoted themselves to its agricultural welfare. Only two British officials now remain with the Department, Mr. J. F. Webster as Inspector-General, and Mr. Evan Guest as Director of Research, both of whom have contributed notably to the development of cotton in the country, The executive control of the Department is in the hands of the Director-General Anwar Bey Khaiyat, and several Iraqis trained abroad as agriculturists are now successfully filling posts formerly occupied by foreigners, a fact that augurs well for the future. King Faisal of Iraq maintains a keen interest in cotton-growing, and by growing several hundred acres yearly set an example to his people which was of special value when the crop was less firmly established. It is not, however, among the highly placed alone that cotton-growing finds its successful exponents, and exceptional yields are obtained by independent peasants who cultivate a few acres on their own account.

So long as the ginnery of the British Cotton Growing Association was the only one in the country, the task of maintaining a pure seed

supply was fairly simple, and it is unfortunate that those Iraqis responsible for the recent erection of another ginnery did not realize the economic disadvantages of increasing the capital outlay on ginneries when the existing facilities were more than ample for several years ahead.

On behalf of the Department of Agriculture, the British Cotton Growing Association continue, as before, to issue approved seed for planting, and to maintain detailed registers of the cotton plantations and the seed that is issued to each.

The present crisis in the cotton industry has taught the farmer how to cut his costs to a minimum, and when a revival in prices takes place it may be confidently anticipated that a considerable increase will take place in the cotton production of Iraq. The Oil Agreement by which the Government receive an annual payment of £400,000 should relieve their financial difficulties, and enable them not only to strengthen the Departments of Agriculture and Irrigation, but to embark on a definite policy for the agricultural regeneration of the country.

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STUDIES ON BLACKARM DISEASE OF COTTON—II

BY

R. E. MASSEY,

Sudan Government Botanist.

I.—Introduction.

In a note published in the Annals of Botany, 1927 [15]*, the writer recorded a series of experiments on Angular Leaf Spot of Cotton which disclosed an apparent relationship between the temperature of the soil at sowing and the development of the disease. It was found that when infected cotton seeds were sown in pots under varying conditions, the greatest amount of infection was obtained with soil temperatures between 20° and 32° C., the maximum amount occurring between 24° and 26° C. Below 20° C. and above 32° C. little or no infection was obtained on the seedlings, and based on these results the theory was propounded that the development of Angular Leaf Spot and Blackarm in the Sudan was connected with rainfall, which not only cooled the soil, but, by reason of the increased relative humidity, rendered the plants highly susceptible to the parasite *Bacterium malvacearum*, E.F.S. The spread of the disease in the field by rain was also described.

This introductory note was followed in 1929 by a longer article published in this Review [16], in which the soil temperature theory was re-examined at length by experiments in which the temperatures employed were more accurately controlled. The results obtained substantiated the earlier work in that infected plants were obtained only within the comparatively narrow range mentioned above.

In addition the progress of the parasite was followed through the tissues of highly infected plants, when it was found that the normal path is intercellular, and is primarily not vascular, but confined to the cork.

In the plants examined few of the organs escaped infection, and in particular it must be mentioned that the bacterium had gained access to the seed, which led to the belief that surface disinfection of the seed coat was not a complete remedy for the control of the disease in the field. Disinfection by prolonged heating of the seed at 70° C., after a preliminary drying at 60° C., was suggested to overcome this difficulty.

* The numbers in brackets refer to "references cited" at end.

The climatic peculiarities of the three principal cotton areas of the Sudan were described, with special reference to the incidence of rainfall at sowing, and it was explained that the immunity of the Tokar district could be correlated with the absence of rain and the high soil temperatures prevailing at this critical period. *Vice versa,* the susceptibility of the Gezira zone was attributable to the fact that sowing normally took place about the peak of the annual rainfall curve, when temperatures were low and humidity high. It was shown that the disease might be checked partially or even totally by the onset of hot, dry weather such as is frequently experienced at Kassala after the rains. Following on the above the recommendation was made that sowing should be delayed until the peak of the rainfall curve was passed, and that individual sowings should be made in soil which had been allowed to heat up to 30-32° C. Details were given of a practical field test made in the Gezira demonstrating the above principles, and of a small scale experiment conducted at Shambat, in the Khartoum district, in which healthy and diseased cotton plants were raised at will from the same batch of infected seed.

The widespread infection of the cotton crop in the Gezira following the floods of 1929 led to a re-examination of the question of the transmission of the disease by seed, and a search for other sources of infection [17].

A prolonged examination of sowing seed from various sources showed that whilst internal infection did occur, in the majority of cases the parasite rested in dried slime adhering to the fuzz on the seed coats. The dissection of many green and dried bolls proved that the infection of the boll contents resulted from the intrusion of bacterial slime from lesions situated either in the base or on the walls of the boll. Mature plants infected in different degrees of severity were also examined, when localization of the disease was proved to be the rule, and the continuous infection described previously was found to be rare.

The parasite was shown to possess remarkable powers of resistance to light and dry heat when embedded in slime, and the possibility of the carrying-over of the infection from one season to another on infected plant remains was proved, as long as the material was kept dry. The parasite disappeared rapidly in unsterilized river water and in wet soil, whether added in the form of cultures or naturally infected plant remains.

The present studies, by reason of the increased information obtained, should assist to a better understanding, not only of the

disease under field conditions, but of the apparently divergent results which have been obtained in the past [*cf.* 17 and 18]. A certain amount of recapitulation is necessary for the sake of clarity, and also to introduce corrections to views held at an earlier stage in our researches; but once again much technical detail is omitted in order to present as brief an account as possible. Every statement made, however, is the result of repeated examinations in the laboratory.

II.—Some Characteristics of B. malvacearum, E.F.S., affecting Present Studies.

The parasite is a pleomorphic (see Fig. 1), strictly aerobic, highly motile, slime-producing, moisture-loving organism. It is now believed that a true capsule is not formed, and that the optimum temperature for growth is about 28° C., and not 24° C. as stated earlier [15]. Experiments with culture media have shown that not only is a carbohydrate necessary to promote luxuriant and rapid growth, but that virulence may be lost by repeated subculturing on to a medium free from carbohydrate. Stress must be laid on the fact that abundant moisture and air are vital to its activities at all stages, for many of the discrepancies which have arisen are due to an insufficient consideration of this fact.

Embedded in dry slime the organism is highly resistant to dry heat and sunlight, and can survive on, or in, dried plant remains for a long period, certainly longer than usually intervenes between successive crops. It seems definite that the rate at which the bacterial slime dries affects the vitality of the bacteria themselves. It has been found that should the slime dry too quickly the contained bacteria may be killed, and this apparently occurs in nature. The fact becomes of interest in experimental work, for naturally infected seed has proved to be more satisfactory for the study of primary infection than that artificially treated.

Another point of importance is that the free swimming bacterium is distinctly delicate, and is very susceptible to drying and excessive heat, though sunlight has little effect. Failures in work involving artificial inoculations of seed, etc., in the early stages of our investigations may be ascribed to this fact.

Finally, although the bacterium when isolated directly from its host plant shows a remarkable uniformity, variant types, lysogenic strains, resistant forms, and filterable forms have been encountered in cultural work, but await further examination next

season, when conditions will be more suitable for a correct evaluation of their significance in the field.

III.—The Parasite in Relation to Soil Moisture and Temperature.

The writer has always believed that from its earliest stages the development of the disease bears a direct relationship to rain, and has laid stress on the lowering of the soil temperature which accompanies rain in the Sudan [15 and 16]. It was soon evident, however, that temperature, although important, was not the only factor involved, and that the water content of the soil at the time of germination played a great part in controlling the activities of the parasite.

Observations in the laboratory have shown that abundant water is necessary for active growth of *B. malvacearum*, and that varying results may be obtained according to the amount of free water present. Two simple observations will illustrate the point: (*a*) If slime-covered lint from an infected boll, or infected fuzz from a seed, is mounted in water and watched under the microscope at room temperature—*i.e.*, 25-30° C. (see Fig. 2)—the development of motility bears a direct relation to the amount of water employed. If relatively little water is used, motility will be seen at the edges of the drop only; but if much water is used relative to the slime, motility may commence throughout the drop within thirty minutes, and persist for several days. In this connection it may be noted that an aqueous extract of soil gave rise to more active movement than distilled water. (*b*) The relative rate of growth of the organism on culture media also bears a direct relationship to the water content of the media. Active growth will continue at higher temperatures on moist media than on agar slopes which have become somewhat desiccated with age.

It will be shown later that soil temperature and water content are intimately related in nature, but a practical demonstration of the possibility of raising healthy or infected cotton plants at will in the Gezira during the rainy season was again [16] made early in the season at the Gezira Research Farm, by sowing seed infected to the extent of 10-15 per cent. under varying conditions. A meteorological chart is included at the end of the present article, and should be consulted at this stage.

Experiment 1.—A plot about half a feddan in size was divided into four subplots, ridged for irrigation, and watered at the end of July. Infected seed was sown on August 1st, whilst the soil was

still fairly wet. Rain fell the same evening, and was followed by further storms. Lesions appeared on the cotyledons of the seedlings on the 10th of the month, and Blackarm was present over the whole plot by the 25th August, on which day the seedlings from three of the subplots were pulled up. By this time the ridges of the plots were somewhat damaged by rain; two plots were therefore repaired, but the third was untouched. On September 3rd these three subplots which had borne infected seedlings were again sown with infected seed (*a*) on the top of the ridges, (*b*) half-way down the ridges, and (*c*) on the broken ridges, but no water was given until the 21st September. The weather following sowing was hot and dry, with the result that no lesions were seen amongst the seedlings of the resown plots.

Experiment 2.—A companion and adjacent plot was sown with lightly infected seed (3 per cent.) during the dry spell which occurred during the middle of August, care being taken to obtain a moist (not wet) and consequently warm seed bed, with the result that seedlings were obtained free from primary infection. Soil temperature at 4 inches varied between 24° and 37° C.

The association of primary infection and rainfall is accepted in the Gezira, and this fact considered in the light of the moisture requirements of the parasite has led to a re-examination of the problem. A careful investigation is being conducted in our laboratories under the charge of Mr. T. W. Clouston, and while it would be premature to publish the results in full, the following summary may help to bridge the gap between our first recorded field observations and the more recent experimental work described herein.

(*a*) *Infection and Soil Moisture.*—Experiments were carried out in which cotton seeds were sown in Gezira soil to which had been added varying quantities of water to give a range of 25, 30, 35, 40, 45, and 50 parts of water to 100 parts of air-dried soil. The seeds were artificially infected by coating the exterior with the slime from a two to three days old culture of *B. malvacearum* grown on glucose agar. The control series contained untreated seeds. Glass tumblers embedded in sand were used as containers, and the experiments were conducted in large glass-sided chambers in which the humidity was maintained about 75 per cent. R.H. The soil temperature was not allowed to fall below 25° C., but during the day the temperature within the cupboards rose to 30° C., and occasionally 35° C.

Satisfactory germination was obtained with soil moistures between 25 and 45 parts of water to 100 parts of dry soil, but below 30 parts

water to 100 parts soil the percentage of infected seedlings obtained was negligible. Above 30 parts water to 100 parts soil infection increased progressively up to 50 parts water to 100 parts soil, when both germination and the development of infection were adversely affected.

Where sand was used instead of Gezira soil, infection occurred between 10 and 20 parts water to 100 parts sand, while germination was obtained with as little as 5 parts water to 100 parts sand. The rate of infection in the various water contents followed the same course as for Gezira soil, from which it is concluded that free water in the soil is essential for the translocation of the parasite from the outside of the seed to the cotyledons within, and that germination may take place with soil moisture contents too low to promote infection. This is a most important fact. It may be noted that the clay soils of the Gezira retain water to a remarkable degree, and it is doubtful if free water exists below 27-28 parts of water to 100 parts of dry soil. The wilting point for cotton is lower, being between 20 and 22 parts of water to 100 parts dry soil.

(*b*) *Soil Temperature and Infection.*—Soil temperature experiments have figured largely in past work, but it is only recently that they have been studied experimentally along with varying moisture contents of the soil, the reason being simply pressure of work. It will be understood that it is impossible to maintain constant temperatures of both soil and air without an expensive cooling plant. Heat can be provided cheaply and efficiently, but to cool large chambers below the temperature of the air is a difficult problem. We have been compelled, therefore, to work with chambers in which the air and soil temperatures were not allowed to fall below a certain minimum. The experiments were nevertheless an improvement on the earlier work of the writer in that the moisture contents of the soil and the humidity were taken into consideration. Results have not been satisfactory in that the amount of infection obtained in the chambers was never high. All that can be said is that the maximum temperature at which lesions were formed on seedlings grown under such artificial conditions varied with the soil moisture and the relative humidity. It appeared definite, however, that at and over 40° C. little or no infection occurs no matter how favourable other factors may be. Remembering that in the earlier work [16] soil moisture and air humidity were uncontrolled, the foregoing virtually confirms previous statements, for it will be obvious that as the temperature of the soil rises, so does the increased loss of water by evaporation affect the moisture of the soil. More success has

been obtained by varying the soil temperatures, and the greatest amount of infection has been obtained on seedlings grown with a low night temperature succeeded by a day temperature of 25°-26° C. [10].

EXPERIMENT 3.—Series of pots were suspended from holes in the floor of a glass-sided cage, so that only the top portion of the pots and the growing seedlings were enclosed, while the lower portion was exposed to a dry atmosphere. The evaporation from the lower portions caused a considerable drop in the temperature of the soil within the pots. Night temperatures fell to 15°-16° C., whilst during the day the temperature of the soil was 25°-26° C. Air temperatures were a few degrees above those figures. The soil at the commencement contained 42 parts water to 100 grams of dry soil. The humidity within the cage was maintained at a high level by spraying with water. Evaporation from the soil was thus compensated for. A higher rate of infection was obtained in this manner than in any other experiments of this series, 71 per cent. of the seedlings showing lesions nineteen days after sowing.

(*c*) *The Effect of a Temporary Chilling of the Soil.*—A diminution in temperature combined with an increase in soil moisture, up to forty-eight hours after sowing, has been found to increase infection very markedly (see Survival of *B. malvacearum*, later).

One experiment in which the soil temperature was decreased and the moisture increased by watering with iced water may be recorded.

EXPERIMENT 4.—Pots containing seeds or seedlings were chilled by watering with iced water at different intervals from sowing. The soil temperature was thus reduced for a short period to 15°-16° C., but subsequently rose to 29°-30° C.

	Per Cent.
(1) Average per cent. of infection in seedlings chilled at various times up to forty-eight hours after sowing	37·0
(2) Infection in seedlings chilled seventy-two hours after sowing	19·4
(3) Seedlings not chilled	19·7

The writer now believes that the effect of rainfall in promoting seedling infection is explained by this simple experiment, and that rainfall within forty-eight hours of sowing is the primary cause of the trouble in the Gezira. It is probable that the chilling produces a lowered resistance within the plant [10], for the parasite is not seriously affected by such a change in temperature. The reason for the time limit will be explained later.

(*d*) *The Rate of Germination in Relation to Infection.*—It is common knowledge that the rate of the germination of cotton seed is governed

by the amount of available water, and the temperature of the seed bed. Experiments have shown that between 25°-30° C. the time required for the splitting of the seed coats preparatory to germination decreases as the soil moisture increases from 25 to 45 parts to 100 of dry Gezira soil. At 50 parts water to 100 parts dry soil, however, there is a decrease in the rate of germination due to water-logging. Now we have already noted that below 30 parts water to 100 dry soil infection of seedlings is negligible, and it was also found that at 50 parts water to 100 soil the amount of infection obtained was again low. Between these two extremes the amount of infection obtained on seedlings grown from infected seed was directly proportional to the rate of the splitting of the seed coats. In other words, the amount of infection obtained was directly governed by the opportunity given to the parasite lying on the surface of the seed to be freed from dried slime, to become motile, and to find its way through a film of free water into the germinating seed. The inhibiting effect on primary infection of a high soil temperature in the Gezira is associated with a soil moisture content sufficiently high to induce germination, but too low for the parasite to become active. The suspension of infection caused by water-logging appears to be due to a retardation of germination and a dying-off of the parasite before the seed opens.

IV.—The Spread of the Disease in the Field.

While it is generally acknowledged that the spread of Blackarm disease throughout the crop is associated with heavy and driving rains, as is the case with many other bacterial diseases of plants [2 and 11], transmission of the disease from plant to plant by other agencies does not appear to have been studied.

Accordingly a series of cages was constructed in which cotton plants could be grown to maturity under shelter. These cages consisted of a framework of wood, 220 cm. long, 134 cm. broad, and 173 cm. to the top of the pent roof. With one exception the roofs consisted of Windolite, and the sides and doors of all were covered with a white, closely woven jute cloth, and were fitted with glass inspection windows.

Cotton plants were raised in 4-gallon petrol tins which were sunk in the ground. The soil employed was washed with chlorine water followed by well water, and seed which had been heated for seven days at 70° C. was employed throughout, previous tests having shown it to be free from *B. malvacearum*. Ventilation slats were

provided at both ends, under the pent roof. In spite of the fact that the cages were in full sunlight, the seedlings presented a somewhat "drawn" appearance. Moreover, the soil temperature was slightly high for our purpose, the self-recording thermometers remaining remarkably steady at 30° C. An attempt to lessen the internal temperature was made by fitting the doorways with a muslin screen, but the doors were invariably closed at night, or when rain threatened. In spite of these drawbacks, lesions did appear in certain cages in sufficient quantity to warrant the belief that their use was justified, and the work will be repeated during the coming season.

Cage No. 1 served as a control to the whole series, and was sown with heated seed on 14th August, 1930, and watered with water from a deep well during the whole period of the experiment. No lesions appeared at any time, and the plants, though somewhat "drawn," remained free from disease.

EXPERIMENT 5: *Cage* 2. *Infection via the Soil.*—The question of the survival of *B. malvacearum* in the soil will be dealt with later; it need only be mentioned that after repeated failures it was demonstrated that by infecting the soil and sowing immediately it was possible to produce seedlings bearing the characteristic watery spots, even when disinfected seed was employed. In other words, under certain specific conditions infection can arise *via* the soil.

Cage 3. *Transmission by Water.*—In this cage also our early trials met with failure, but eventually it was found that germinating seed can be infected *via* water under conditions which will become apparent later. Heated seed and chlorinated washed soil were used.

Cage 4. *Infection from Dry Plant Remains carrying B. malvacearum.*—Difficulties were encountered in this cage, but after the matter had been examined in the laboratory, germinating seed was successfully infected from dried bolls of last season's crop, gathered from the field and spread on the surface of the soil. Heated seed, chlorinated and washed soil, and well water were used in this instance.

Cage 5. *Transmission via the Seed.*—Seed proved to be naturally infected was sown in chlorinated and washed soil, and watered with well water on 14th August. A few lesions appeared on the cotyledons in due course, but the infection was never heavy within the cage. Naturally infected seed was found to be superior to that infected with slime in the laboratory.

Cage 6. *Transmission through the Air in the Absence of Rain.*—Heated seed and clean seed were sown in rows on August 14th with the precautions outlined above. Infected seedlings were not allowed

to touch the healthy plants, and watering was conducted from below. In no instance was there any spread of infection.

Cage 7. *Transmission by Insects.*—The arrangements described in Cage 6 were repeated in Cage 7, except that the muslin curtain at the doorway was omitted and insects allowed free ingress. No case of plant to plant infection occurred.

Cage 8. *Transmission by Drainage Water.*—It was hoped to demonstrate the transmission of Blackarm by water draining from an infected area, but the requisite conditions were not understood, and the experiment was a failure. The efforts made, however, led to an examination of the causes underlying the lack of success, with results which will be described in detail at a later stage (*cf.* soil, water, and debris infection).

Cage 9. *Transmission through Dry Air.*—This cage was virtually a repetition of Cage 1. The door was guarded by a muslin curtain to exclude insects, but was otherwise kept open except when rain fell.

No infection whatever was found on the enclosed plants throughout the experiment.

Cage 10. *Transmission by Rain.*—The roof of Cage No. 10 consisted of light muslin only. The precautions outlined above were taken to secure healthy plants within the cage. Seed was sown on 14th August, and the plants remained healthy until 1st September, when typical Angular Leaf Spot lesions were observed on the leaves of some of the plants. The amount was never large, as the surrounding land lying in the direction of the rainstorms was not sown with cotton. Nevertheless, unmistakable lesions appeared, and were visible for six weeks after the commencement of the experiment.

Less critical demonstration of the transmission of Blackarm by rain was obtained by sowing seed which had been heated to 70° C. for seven days, in varying positions relative to plots carrying infected cotton, when the degree of infection on the seedlings grown from the heated seed was governed by the direction and intensity of the rainstorms.

Stoughton [18] has studied the conditions requisite for the development of Angular Leaf Spot of Cotton, and comparison between his results and the meteorological chart for 1930 of the Gezira will show that during the rainy season in the Gezira conditions were frequently favourable for the spread of the disease; indeed, it seems certain that transmission of the disease by rain is fundamentally the most important factor to be reckoned with.

The interesting observation recorded by Lewin [5] in Nigeria, that cotton grown in mixed cultivation with the yam showed considerably

less infection than when grown by itself, was paralleled last season in the Gezira, when the thick growth of a wild Ipomœa amongst the young cotton definitely lessened the degree of rain-borne infection. Presumably the weed broke the force of the rainstorms, and so lessened the spread of infected spray.

In connection with transmission by rain, it will be obvious that, as the parasite enters *via* the stomata, the degree of infection obtained will depend on whether the stomata are open [16], and also on the rate of evaporation of the surface film of water on the leaf surface. This rate of evaporation is governed by the vapour tension of the atmosphere, the temperature, the rate of air motion, and the barometric pressure; should the infected droplet evaporate rapidly the movements of the contained bacteria will be restricted, or even stopped completely. It may also be mentioned that motility and growth are not necessarily associated, for whereas growth ceases below 37° C., motility may continue up to and above 40° C. [17].

V.—The Latency of the Parasite Within the Tissue of the Host.

For the purpose of this article latency is taken to mean the presence of the parasite within the tissues of the host plant without the formation of lesions in the particular area concerned. As work is still in progress a discussion of this aspect of the disease would have been deferred had not the possibility of latency been questioned [19].

Instances have occurred during the past season in which the development of lesions on seedling cotton plants has been suppressed, notably on those suffering from lack of light. Seedlings grown in glass cages have frequently showed none of the characteristic water-soaked areas on the cotyledons within the usual incubation period, but some weeks afterwards the infection has appeared at the first node, and the bacterium has been recovered therefrom. This is, however, abnormal, for a large number of apparently healthy cotton plants have been examined by plating on culture media sections of the stem and leaves, after surface sterilization, without recovery of *B. malvacearum*. Similarly, apparently healthy seedlings grown in pots during the course of the experimental work carried out in the Gezira during the rainy season have been examined for *B. malvacearum* without success.

The presence of lesions resulting mainly from rain-borne infection is often overlooked while the host plant is full of leaf and the infected areas small in number and size. As the season advances, however,

the damage becomes apparent, and has frequently been recorded as a fresh outbreak. Now bacteria cannot grow when the relative humidity of their immediate surroundings falls below 96 per cent., and make most headway in sappy tissues containing large intercellular spaces full of moisture; the progress made by the parasite within its host is therefore controlled by the reaction of the host to environmental conditions.

Irrigation in the Gezira is practised normally at intervals of about fifteen days, and results in the resumption of turgidity and increased water content of the intercellular spaces through which the parasite travels; temporary increase in intensity of infection is therefore to be expected after each watering. Similarly the irregularities in the curve of relative humidity are reflected in the alternate halt and onward march of the parasite within the tissues of its host.

As we have noticed both here and in the past [16], the progress of the disease may be continuous (*e.g.*, frequently in the Gezira) throughout the season, or entirely arrested (*e.g.*, often at Kassala). Partial control of the disease by limitation of soil moisture has been practised by the writer for years, and was undoubtedly the factor responsible for the results obtained in some of his early experiments, in which high soil temperature inhibited or retarded the formation of lesions. A parallel case is found in the bacterial disease of apples and pears known as "Fireblight," which has been controlled in the U.S.A. by keeping the soil moisture somewhat below the optimum for growth of the trees, but well above the wilting point.

It is believed that the behaviour of *B. malvacearum* within the tissues of the cotton plant is similar in all essential features to that of other species of bacterial plant parasites described in recent literature [9]. The organism migrates in the form of slime threads (zooglœæ), which at least in the early stages of the infection are confined to the intercellular spaces of the host. As explained above, the rate of migration is controlled by environmental factors, temperature, moisture, and the condition of the host, and there seems to be no reason why under adverse circumstances the parasite should not lie dormant, or progress so slowly that lesions are not apparent to the naked eye.

VI.—The Survival of B. malvacearum in Nature.

(*a*) *On the Seed.*—In view of the importance of the matter, prolonged examinations were again carried out [17] during the past season of seed suspected to be infected with *B. malvacearum*. Indi-

vidual selected seeds were dissected, and the various portions examined by bacteriological methods. Also seeds freed from the outer coats were sown in different ways calculated to distinguish between external and internal infection. The results were consistent in that no internal infection was found in the samples examined, *B. malvacearum* being isolated from the exterior of the seed coats only.

In explanation of previous statements made in this REVIEW [16] it must be mentioned that the earliest work was carried out on Pima and Ashmouni seed derived from plants infected to a degree never since seen by the writer. These two types of cotton are particularly susceptible to Blackarm disease, and should be avoided where the disease is prevalent. There can be no doubt whatever that internal infection existed as described, for the lesions were often visible to the naked eye on the cotyledons when the seed coats were slipped off; moreover, the parasite could be tracked through the tissues and isolated therefrom with ease. Sakel cotton in the Sudan is more resistant than either Pima or Ashmouni cotton, with the result that the parasite is usually localized, but the possibility of internal infection must never be ignored where the seed is derived from a heavily infected crop.

(*b*) *Survival in the Soil.*—The difficulties encountered in the cage experiments described above have been briefly mentioned (Cages 2, 3, 4, and 8). At the outset, in order to ensure satisfactory results within the small area of the cages, there seemed no reason why seed should not be heavily infected by steeping for a short time in water to which was added a young active culture of *B. malvacearum*. When this method failed to give the expected results it was thought that heavier infection might result if the seed were smeared with the slime from a recent culture, but a heavy infection was never obtained. Again, the use of a decoction of old bolls and stalks known to be infected gave unexpectedly poor results, in that the amount of infection obtained on the seedlings grown in soil infected therewith was small. Finally, the artificial infection of soil with aqueous emulsions of *B. malvacearum* gave unexpectedly varying results. These failures led to a critical examination of the question of the survival of the parasite in soil and water, and later, an investigation into its fate when infected seed is sown.

The factors governing the infection of the seedling during the period of germination have been briefly dealt with above; it is now necessary to consider what happens if the parasite is not successful in penetrating the tissues of the host plant. In the first place, all our efforts to isolate *B. malvacearum* from the soils of the Sudan have

been unsuccessful, except where recent fresh infected debris was visibly present. Similar results have been reported from America with *B. malvacearum*, E.F.S. [5]; *B. citri*, Doidge [14]; *B. michiganense*, E.F.S. [4]; *B. atrosepticus*, V.H. [13]; and *B. tabacum*, W. and F. [11]; the last four being virulent plant parasites giving rise to diseases similar in some respects to Blackarm. This literature was not available, however, at the time when our experiments were in progress, and the natural suggestion was that a time-limit existed for the survival of *B. malvacearum* in soil, since in each case an interval of twenty-four hours or more had elapsed between adding the cultures and the time of sowing. Accordingly the following experiment was set up.

EXPERIMENT 6.—Thirty flower-pots were filled with sifted Gezira soil and moistened with well water. A strong suspension of a three-day culture of *B. malvacearum* known to be virulent was added to each plot, and sowing carried out as follows, using seed which had been heated for seven days at 70° C.

Series A sown immediately after adding *B. malvacearum*.
Series B sown six hours after adding *B. malvacearum*.
Series C sown eighteen hours after adding *B. malvacearum*.
Series D sown thirty hours after adding *B. malvacearum*.
Series E sown forty-eight hours after adding *B. malvacearum*.
Series F Control, without *B. malvacearum*.

The experiment was carried out in early September when atmospheric conditions were favourable. Lesions appeared on the seedlings on the eighth day from sowing. After ten days the percentage of infected seedlings was as follows:

Series	A	B	C	D	E	F
Percentage infection ..	49	33	12	10	0	0

EXPERIMENT 7.—The experiment was repeated, but on this occasion the soil was made into a thin mud with a weak suspension of *B. malvacearum*.

Series A sown immediately after adding *B. malvacearum*.
Series B sown six hours after adding *B. malvacearum*.
Series C sown eighteen hours after adding *B. malvacearum*.
Series D sown thirty hours after adding *B. malvacearum*.
Series E sown forty-eight hours after adding *B. malvacearum*.
Series F sown sixty-six hours after adding *B. malvacearum*.
Series G Control, *i.e.*, no *B. malvacearum* added.

The first lesions were visible on A series on September 22nd, *i.e.*, eight days from sowing. After twelve days a count of infected seedlings gave the following percentages:

Series	A	B	C	D	E	F	G
Percentage infection ..	72	40	17	7·5	0	0	0

Experiment 8.—These results were so striking that the experiment was again performed at Shambat later in the year, using a lighter soil.

Series A sown immediately after watering with *B. malvacearum.*
Series B sown twelve hours after watering with *B. malvacearum.*
Series C sown twenty-four hours after watering with *B. malvacearum.*
Series D sown thirty-six hours after watering with *B. malvacearum.*
Series E sown forty-eight hours after watering with *B. malvacearum.*
Series F sown ninety-six hours after watering with *B. malvacearum.*
Series G Control, no *B. malvacearum* added.

Soil temperature and air humidity were very low at this time (November 8th to December 22nd) and lesions few and slow to appear, so much so that the experiment was about to be discarded, when it was noticed that the first nodes were showing signs of infection. Forty-four days after sowing the plants were again examined and the following count obtained:

Series	A	B	C	D	E	F	G
Percentage infection ..	?	66	33	25	11	2	0

Experiments Nos. 6 and 7 suggested that there was a genuine dying out of the organism in moist unsterilized soils; accordingly a return was made again to bacteriological methods, of which the following experiments are examples:

Experiment 9.—Four flasks were set up as follows:

Flask A : Unsterilized Gezira soil made into a thick mud and inoculated with a concentrated suspension of *B. malvacearum.*
Bacteriological examination made after twenty-four, forty-eight, and seventy-two hours.
Result—*B. malvacearum* was not isolated.

Flask B : River water turbid with the characteristic brown Nile sediment was inoculated with *B. malvacearum* and examined after twenty-four and seventy-two hours.
Result—*B. malvacearum* was not isolated.

Flask C : As A, but mud partially sterilized in the autoclave before adding *B. malvacearum.*
Result—The parasite was isolated after six days, but not after fourteen days.

Flask D : As B, but the river water was sterilized as C before inoculation.
Result—*B. malvacearum* was recovered after twenty-seven days.

Experiment 10.—Soil taken from a plot bearing heavily infected cotton was placed in a large flower pot and heavily inoculated with a suspension of a culture of *B. malvacearum* isolated a few days previously from the plants of the same plot. The pot was buried

in the soil and sampled at intervals. Bacteriological examination of the samples resulted in the isolation of a few colonies of *B. malvacearum* after twenty-four hours, but none after forty-eight hours or thereafter up to five days from the commencement of the experiment.

EXPERIMENT 11.—Soil from the immediate vicinity of the seedlings mentioned in Experiment 8 was examined, but the parasite was never recovered. This experiment is typical of very many examinations made throughout the season of soil gathered from various parts of the Gezira.

(*c*) *Survival in Water*—(i.) Rain Water.—Repeated efforts were made to isolate *B. malvacearum* from rain water collected in glass flasks placed in the open, away from growing cotton, but no success was obtained. Attention was then directed to the plots containing infected plants, and samples of rain water lying in the ridges were examined bacteriologically immediately after collection and also next day. *B. malvacearum* was isolated six hours after a rainstorm, but not after the rain water had stood twenty-four hours. The number of *B. malvacearum* in one trial was calculated to be about 20,000 per c.c.

(ii.) Precisely the same results were obtained with drainage water, and in fact any water gathered from the cotton fields failed to show the presence of *B. malvacearum* after standing twenty-four hours in contact with the soil. *B. malvacearum* has not been isolated by us from irrigation water collected direct from the canals, nor have we recovered the organism after a period of twenty-four hours in experiments in which raw river water was inoculated with a culture. *B. malvacearum* has been recovered from distilled water on several occasions without difficulty a month after inoculation.

(*d*) *Survival on Infected Plant Remains.*—The survival of *B. malvacearum* within plant remains was briefly dealt with in this REVIEW last year [17], and the opinion was expressed that the recurrence of the disease might be due to the carrying-over of the infection from one season to another in fallen debris. This aspect of the problem, therefore, figured largely in our programme, and Cage No. 4 was devoted to the demonstration of the infection of germinating seed by the parasite contained in dried bolls gathered from last season's plots. In the first instance the debris was soaked for twenty-four hours, and the clear liquid used to water the sown seed, with the result that not a single lesion appeared on the seedlings. It is worth noting that the seed contained in the debris sprouted after the soaking and gave seedlings which were all clean, and this in spite of the fact that the presence of *B. malvacearum* had been

proved at the commencement of the experiment by bacteriological examination.

Finally clean seed was sown in moist soil which had been partly sterilized, and after a few hours infected debris was strewn on the soil and the whole watered fairly heavily. In this way a small amount of infection was obtained on the resulting seedlings.

As the experiments were conducted simultaneously with the work on the survival of the organism in wet soil, it was concluded that while infected debris is a definite source of danger, the parasite released therefrom by water must have ready access to its host for infection to result—in other words, there is a time factor operating as in the case of soil. The matter was, however, too important to be left without further investigation, and bacteriological examinations were made of rotting debris in the laboratory. This work was the most difficult undertaken owing to the large number of saprophytic organisms present, and one was left with a feeling of uncertainty, even though a large number of inoculations of likely colonies into seedlings produced no lesions. It was therefore decided to delay the decomposition of the infected bolls by soaking them in water which was kept constantly aerated, and to examine the water at intervals for the presence of *B. malvacearum*. The plan was successful in that decomposition was avoided, but the plates were overgrown with a rapidly growing slime organism, and *B. malvacearum* was not isolated after soaking for twenty-four hours.

Bacteriological methods having failed to give satisfaction, an experiment was carried out in which debris was soaked for twenty-four and forty-eight hours and seed germinated therein for twenty-four hours, distilled water or river water being used as indicated below.

Experiment 12.—Five large dishes were employed, four of which contained dried infected bolls soaking in water. The fifth contained clean seed only with sufficient water to cover the seed.

Dish 1 : 150 clean seeds added at once and the whole soaked for twenty-four hours (distilled water used).

Dish 2 : 150 clean seeds added after soaking the debris for twenty-four hours, the whole then soaked for another twenty-four hours (distilled water used).

Dish 3 (*a*) : 150 clean seeds added after soaking the debris for forty-eight hours and the whole soaked for another twenty-four hours (distilled water used).

Dish 3 (*b*) : As 3 (*a*) but river water (unsterilized) used.

Dish 4 : No debris, clean seed and distilled water.

It will be seen that the seed was soaked in each case for twenty-four hours only, after which it was sown in pots.

The amount of infection obtained on the seedlings was as follows:

Dish 1: Debris soaked in distilled water for twenty-four hours, 11 per cent.

Dish 2: Debris soaked in distilled water for forty-eight hours, 10 per cent.

Dish 3 (*a*): Debris soaked in distilled water for seventy-two hours, 55 per cent.

Dish 3 (*b*): Debris soaked in river water for seventy-two hours, 20 per cent.

Dish 4: Seed alone soaked twenty-four hours, 0 per cent.

EXPERIMENT 13.—Debris consisting mainly of fallen bolls, in which the presence of *B. malvacearum* had been proved by cultural methods, was buried in Gezira soil contained in large flower pots at the depth of 1-2 in. below the surface and kept moist by daily watering.

Platings were made on to culture media at intervals of twenty-four and forty-eight hours, but the plates were overgrown with saprophytic organisms as usual. Decomposition was still in progress after sixteen days, when the top layers of soil were extracted and distributed into small flower pots, clean seed being sown therein, care being taken that intimate contact of seed and rotting debris was made. Three weeks after sowing the seedlings were still healthy. An attempt to extract a bacteriophage from the rotted debris was unsuccessful (see later).

The necessity for coping with seed disinfection on a large scale, coupled with the rising temperature due to the arrival of summer, has necessitated the postponement of the work until next August; but sufficient evidence has been obtained to show that although the parasite liberated from debris has normally a short life in the soil, it may yet constitute a definite source of danger. The danger may be lessened, if not eliminated, by watering infected plots at the end of the season. Fortunately in many parts of the Sudan we have a powerful ally in the White Ant, which rapidly disintegrates organic matter left on or in the soil, but if seed disinfection should fail to give complete control of the disease on a large scale it seems probable that the cause will lie in the dry infected remains of the previous crop which have escaped destruction.

VII.—On the Decline of B. malvacearum, E.F.S., in Soil and Water.

It will be understood that only an indication can be given here of the mass of experimental work carried out during the past season, but enough has been recorded to demonstrate that our failure both to secure satisfactory infections in the cage experiments, and to isolate the parasite from unsterilized soil and water has been due to the rapid decline of the organism in wet soil and river water. The obvious importance of this phenomenon necessitated further inquiry, and a consideration of the known facts suggested the presence of a bacteriophage. After a number of preliminary trials d'Herelle's technique [8] was adopted for the detection and enhancement in virulence of the extracted phage. Some details are necessary.

Nutrient broth was prepared:

Lemco	0·5 per cent.
Peptone	1·0 ,, ,,
Salt	a trace

adjusted to 7·4 pH with sodium hydroxide solution, sterilized for twenty minutes at one atmosphere, filtered and tubed in measured quantity (5 c.c. each tube), and again sterilized. The reaction is important, as a trace of acidity was found to inhibit the action of the phage.

The material under examination—*i.e.*, soil, water, etc.—was added to 250 c.c. of broth and incubated at 25° C. for twelve hours, after which the coarse particles were filtered out through filter papers and the filtrate passed through a L_3 or L_5 Chamberland candle under low pressure. Tubes containing 5 c.c. of broth were inoculated with a suspension in normal saline of a twenty-four-hours old culture of *B. malvacearum* grown on glucose peptone agar, which had been proved to be free from lysogenic properties, until a slight turbidity was visible.

The requisite dilutions of the filtrate (phage) were then added to the tubes, and the whole series under investigation inoculated at 25° C. The control tubes contained *B. malvacearum*, but no filtrate from the soil, and rapidly became more turbid owing to growth of the bacterium. A detailed account of the work would occupy too much space; it is therefore proposed to summarize the results, and to deal with this interesting phase of Blackarm research in a special article.

Our conclusions, in so far as they affect the problem of the control of Blackarm in the field, are as follows:

1. A transmissible lytic principle (phage) has been isolated from both fallow and cultivated Gezira soils.

2. In fallow soils without addition of *B. malvacearum*, only indications of its presence have been obtained in the original filtrate. If, however, *B. malvacearum* is added before the first filtration, a weak phage can be extracted, and subsequently increased in virulence.

3. A transmissible lytic principle (phage) definitely stronger than that obtained from fallow soils has been isolated from the surface of the plots bearing diseased cotton, and demonstrated in the first filtrate by the clearing of the inoculated broth tubes described above, and also by the formation of plaques—*i.e.*, clear spaces—on solid culture media (see Figs. 7 and 8).

4. The virulence of the lytic principle has been enhanced by repeated inoculations and filtrations until in the case of the seventh filtrate temporary clearing took place in dilutions of 1 in 100,000,000 of the filtrate, turbidity returning after ninety-six hours when incubated at 25° C. The undiluted seventh filtrate remained clear for fourteen days. Rapidity of action was also increased, clearing being definitely visible after six hours in the third filtrate.

5. The presence of a phage in turbid Blue Nile river water was demonstrated during the flood, but the experiments conducted with clear water from the Main Nile in January were uncertain.

6. When added to soil heavily inoculated with *B. malvacearum* the results obtained with the phage have been partially successful only, but a suitable technique has not yet been evolved.

7. Phage has not been isolated from old dry infected leaves, decaying debris, nor has it been detected in rain water.

We are greatly indebted to the Government Bacteriologist, Dr. Douglas Riding, M.D., B.Ch.,* for an independent isolation and examination of the transmissible lytic principle described above. Dr. Riding's report is strictly technical, and for this reason cannot be given in full in this paper. He concludes, however, that:

(1) The specimen culture of *B. malvacearum*, E.F.S., provided shows evidence of an inherent lysogenic activity.

(2) Filtrates of soil and Blue Nile river water contain a transmissible lytic principle which resembles the "bacteriophage" in its action on cultures of *B. malvacearum*, E.F.S.

(3) Shiga bacteriophage and extract of chicken fæces had no action on cultures of *B. malvacearum*.

(4) It is impossible to recover *B. malvacearum* from either dry or wet soil to which it has been added seventy-two hours previously by a simple agar technique.

* Wellcome Tropical Research Laboratories, Khartoum.

Numerous experiments were done with suspensions of *B. malvacearum* from young agar cultures, and also with potato cultures, with the above result. Dr. Riding also reports that "A serum produced by the intravenous inoculation of rabbits with live suspensions of this strain of *B. malvacearum*, E.F.S., agglutinated the organism in high titre (1 in 5,000). This agglutinating serum appears to be highly specific, as it readily agglutinates other strains of *B. malvacearum* and has no action on others of the Pseudomonas group and various common soil and water organisms."

The suggestion that a bacteriophage may be actively concerned in the rapid decline of a bacterial plant parasite in wet soil is not new, but no references to previous work on the subject were available when the work described in this note was begun. Kotila and Coons isolated a lytic principle from the soil of plots bearing potatoes infected with Blackleg disease [13] in 1925. Anderson obtained a phage of high potency from soil beneath diseased peach trees in 1928 [1]. Loucks, in 1930, reported that *Ps. citri* died out in unsterilized soils after a few days, thus settling a question which had remained in doubt for many years [14].

Little can be added as yet regarding the variant forms of *B. malvacearum* encountered during the work [6]. When freshly isolated from infected material only smooth virulent forms are obtained, but on certain culture media, and in experiments on the phage, a variant form in which the colonies are more deeply pigmented and firmer in consistency is often met. Strains exhibiting lysogenic activity are common, and such cultures give rise to daughter colonies after varying periods of time.

Lack of time has prevented us from confirming the presence of the filterable form noted in the previous paper [17], but it is intended to devote more attention to the problem next season, for the survival of the organism in nature may be connected with its powers of dissociation and the appearance of resistant forms [7]. The discovery of bacteriophagic action in soil and water, however, encourages the belief that our technique has not failed us, and that the measures advocated for the control of the disease in the field are radically sound.

Discussion of Results.

It would appear from the foregoing that as far as Blackarm disease is concerned the fate of the crop is decided during the period of the germination of the seed.

The earlier observations of the limiting effect of soil temperature

on the activities of the parasite were essentially correct, but were restricted in their scope.

It will be understood without further discussion that during the sowing period in the Gezira a wet soil is a cold one, and as the temperature of the soil rises the free moisture becomes less, with a consequent curtailment of the activities of the parasite.

The deleterious effect of rainfall during the critical period of germination is now clear, for it chills the soil and also supplies the necessary free water to the parasite lying dormant on the seed coats (Fig. 2). Whether the rain water, which has no harmful effect on the bacterium, also dilutes the lethal action of the soil and irrigation water remains to be proved, but is not unlikely.

Given free water and a low soil temperature at the time of germination, the parasite gains access to the cotyledons, and lesions are subsequently formed on the seedlings from which bacteria are liberated in myriads by rain (Fig. 4); in this manner the disease spreads with lightning rapidity throughout the crop.

Field evidence goes to show that the parasite may be carried for considerable distances during and possibly immediately after rainstorms.

The progress of the disease thereafter is determined by the climate, and every gradation between a small localized infection which may even die out and a wholesale invasion of the crop may be experienced, according to the temperature and humidity of the atmosphere during the development of the crop.

A moderately warm, humid winter assists the progress of the disease, while a hot dry season retards and may even suppress it, the final determining factor being the water content of the invaded tissues.

Boll infection, arising mainly from rain-borne bacteria which come to rest either on the bracts or the boll itself, constitutes the principal source of seed infection in the Sudan. The tissues of the base of the growing boll are broken down, with the result that the bacterial slime penetrates into the cavity of the boll and infects the contents (Fig. 5). In this fashion the disease is carried over to the following season.

Dried bacterial slime is highly resistant to all environmental conditions, and on infected seed the parasite has been known to retain its vitality for over two years.

All available evidence goes to show that in wet soil *B. malvacearum* has a short life, and that while infection of germinating seed by bacteria freed from infected debris lying in the soil may take place,

the risk can be greatly minimized by soaking such debris with river water, *i.e.* by irrigation prior to sowing.

Control of the disease lies in the provision of a clean seed-bed and the use of seed free from infection.

In order to lessen the chances of accidental infection the seed-bed should be well ridged and sown with a moisture content sufficient to ensure germination, but insufficient to promote infection.

Sowing should be stopped on the arrival of rain, and surplus rain-water and drainage water led rapidly away.

It is obvious that to delay sowing until the peak of the rainfall curve is passed is to lessen the risks of infection right from the start.

Little or nothing can be done on a large scale once the disease has gained hold on the crop, except the application of the principles of good husbandry.

The risk of infection from plant remains of the previous season must be eliminated by clean cultivation. In rain districts where irrigation is not practised, much could be done by the application of the principles of dry farming. The writer has no practical knowledge of rain cultivation, but suggests that ridging, coupled with the use of seed treated with a disinfectant dust, would materially assist in the suppression of the disease.

Finally, the natural corollary to the above is that the meteorology of any new district should be studied before any cotton-growing project is embarked upon.

Summary.

1. The earlier conclusions on the influence of soil temperature have been re-examined and the opinion expressed that the inception of Blackarm is due to a combination of factors, of which soil moisture and soil temperature are predominant.

2. The previous evidence that infection of the seed is mainly carried externally has been confirmed, but it is recognized that internal infection does occur and must not be ignored. The necessity for the use of clean seed has been emphasized.

3. The effect of rainfall in chilling and in increasing the water content of the soil during the critical period of germination has been studied, the conclusion being that the amount of infection is directly proportional to the rate of splitting of the seed coats and the penetration of the tissues by the parasite, subject to limitation by a time factor imposed by the lethal properties of the soil.

4. The subsequent spread of the disease amongst the growing crop has been confirmed, but no other form of air-borne infection has been detected.

5. The danger existing from infected debris has been emphasized, but it has been pointed out that this danger may be minimized by watering, whereby the contained parasite is destroyed.

6. The rapid decline of *B. malvacearum* in wet soil has been studied, and the opinion has been formed that the life of the parasite in wet soil is limited to a period not exceeding seventy-two hours.

7. The presence of a bacteriophage in the soil of the Gezira has been demonstrated, but its practical significance has still to be studied.

8. The principles underlying the control of the disease in the field have been summarized.

ACKNOWLEDGMENTS.

The present contribution is a continuation of two articles previously published in this REVIEW and is an expression of the writer's views on the subject of Blackarm disease of cotton.

The carrying out of much of the work described therein has devolved upon his assistant, Mr. M. C. Hattersley, with whom he proposes to prepare a more technical account in the near future. The work of Mr. T. W. Clouston, who joined these laboratories in November, 1930, is indicated in the text.

Our best thanks are due to Dr. Riding for assistance in that relatively new subject—at least, to plant pathology—the bacteriophage.

We are also much indebted to Major R. G. Archibald, C.M.G., D.S.O., Director of the Wellcome Tropical Research Laboratories, Khartoum, for the interest he has shown since the commencement of our work on Blackarm.

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ILLUSTRATIONS

Fig. 1.—A typical culture of *B. malvacearum*, E.F.S., twenty-four hours old, smooth form.

Fig. 2.—Dark ground microphotograph of a fuzz hair taken from an infected seed and mounted in water.

The bacteria have been liberated from the slime, and are already motile, for which reason it was impossible to obtain a sharp image.

Fig. 3.—Cotton seedlings showing "Angular Leaf Spot" lesions on the edges of the cotyledons.

Fig. 4.—A single lesion similar to those shown in Fig. 3 mounted in water, and photographed, using the dark ground condenser. This microphotograph was taken as quickly as possible after mounting the lesion, and shows the bacteria oozing in myriads. The lesion prints as a light patch owing to its partial translucency.

Fig. 5.—Section of a young boll showing the typical basal infection. It will be noted that the tissues of the receptacle are eaten away at (x). This cavity was filled with slime which would shortly have penetrated into the cavity of the boll, thus infecting the developing seeds.

Fig. 6.—The same as Fig. 5 at (x), but highly magnified. The bacteria are shown in the broken-down tissues.

Fig. 7.—A culture of *B. malvacearum* attacked by the bacteriophage; the round plaques or cleared areas are clearly shown.

Fig. 8.—A few of the plaques on Fig. 7 slightly magnified.

Fig. 9.—A cotton plant attacked by Blackarm.

Fig. 10.—A later sown cotton plant showing healthy growth.

Note.—Figs. 9 and 10 illustrate a similar experiment to Experiments 1 and 2 (described above), which was carried out at Shambat, where the risks of secondary infection are less owing to the shorter rainy season.

The plot in which Fig. 9 was taken was one of six which were arranged at random, and sown on July 21st, when rains were frequent and heavy.

Fig. 10 is from one of a precisely similar series of adjacent plots, which were sown on September 15th, after the rains had ceased. The suppression of primary infection, the absence of secondary rain-borne infection, and the effect of altered climatic conditions on the development of the plant are clearly shown.

It was unfortunately impossible to obtain a photograph of Experiments 1 and 2 at Medani owing to the lack of equipment.

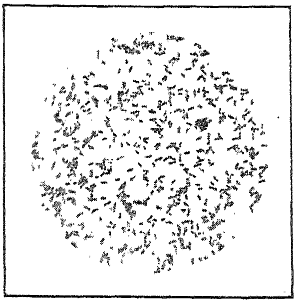


FIG. 1.

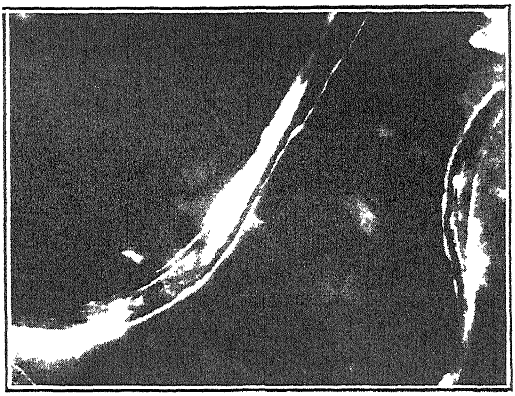


FIG 2.

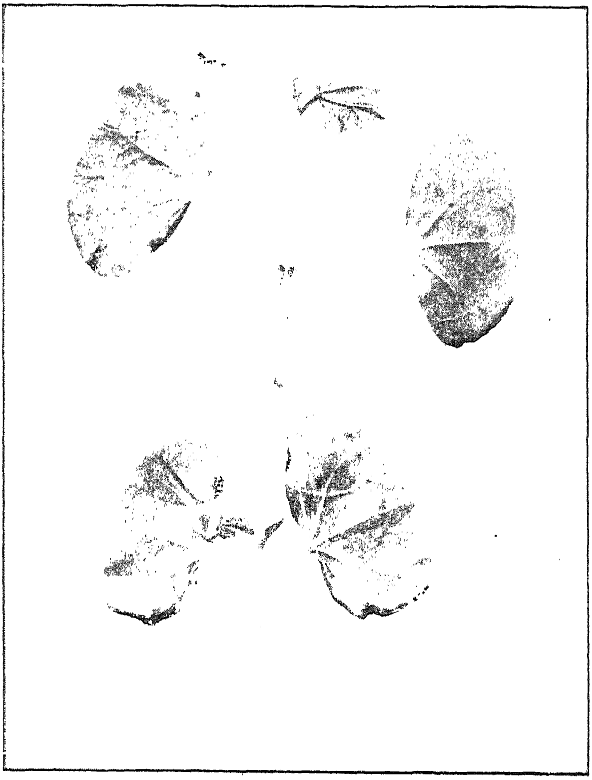


FIG. 3.

FIG. 4.

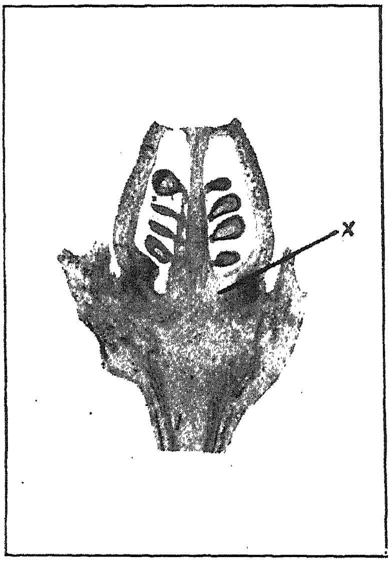


FIG. 5.

FIG. 6.

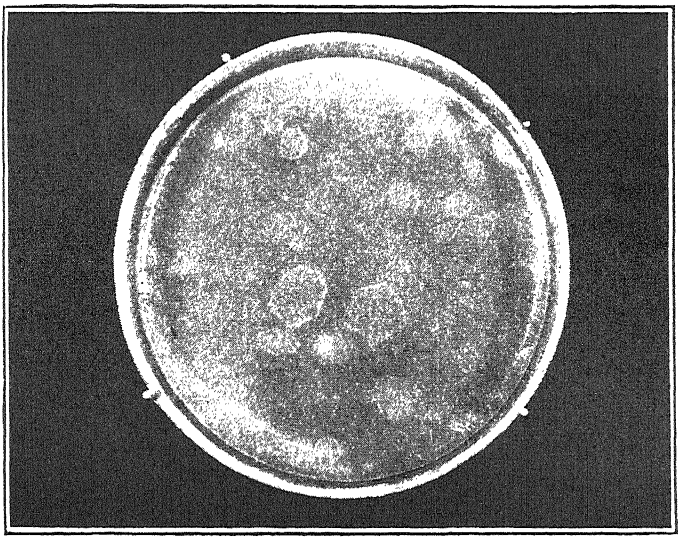


Fig. 7.

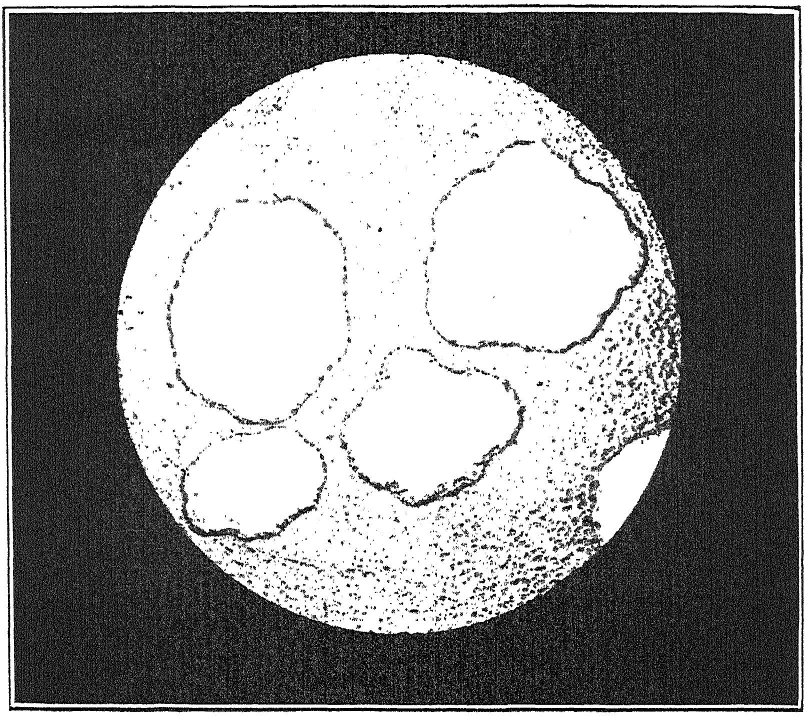


Fig. 8.

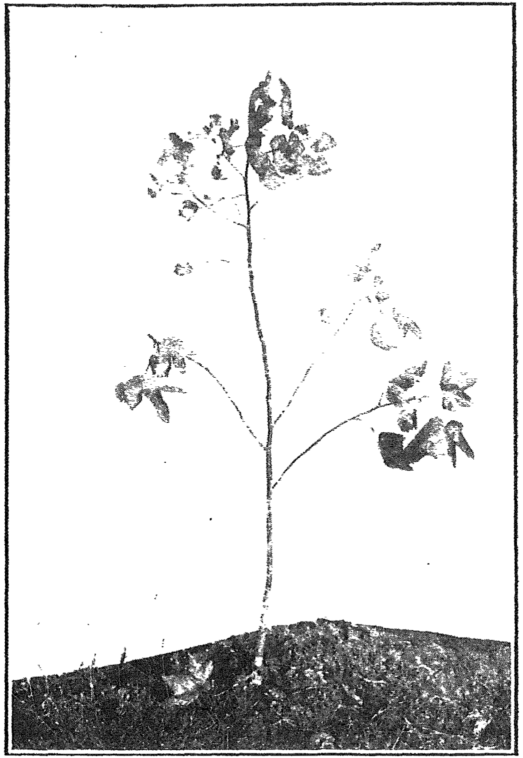
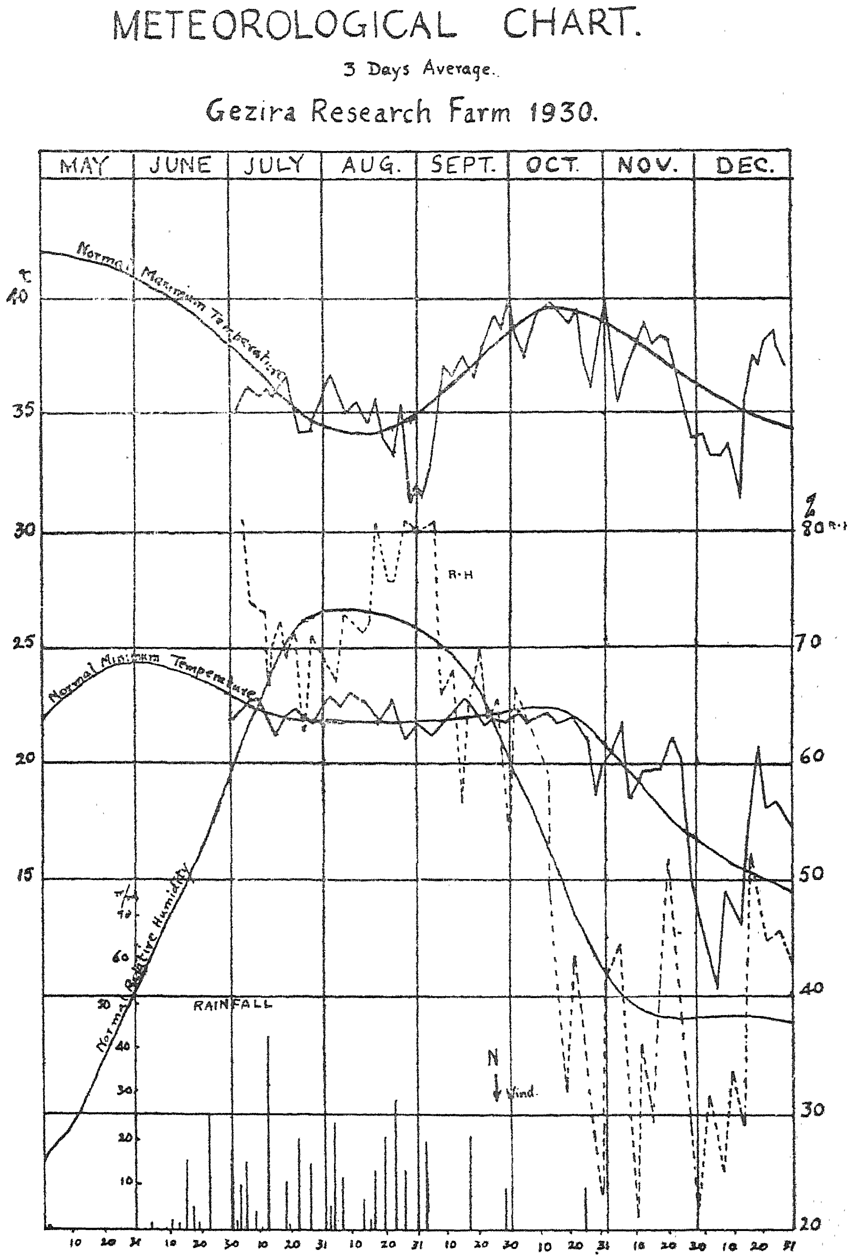


Fig 9.

Fig. 10.


METEOROLOGICAL CHART.
3 Days Average.
Gezira Research Farm 1930.
MAY
JUNE
JULY
AUG.
SEPT.
OCT.
NOV.
DEC.
Normal Maximum Temperature
Normal Minimum Temperature
Normal Relative Humidity
R.H
RAINFALL
N
Wind.
40
35
30
25
20
15
80
70
60
50
40
30
20
10 20 31 10 20 30 10 20 31 10 20 31 10 20 30 10 20 31 10 20 30 10 20 31

HALO-LENGTH MEASUREMENT

At the Conference of Workers on Cotton-Growing Problems held last year, Mr. M. A. Bailey submitted a Note on the desirability of interchange of details of methods employed in measuring halo lengths, and described the method used by him in the Sudan and the celluloid scale devised by him for the purpose.

The Corporation has since received several requests for information as to where these scales could be obtained. Those used by Mr. Bailey were made by himself and his staff, but he has kindly supplied one as a pattern from which the Corporation has arranged for others to be made. Mr. Bailey has incorporated also certain improvements. Thus, a small pad of ivorine or similar material placed immediately beneath the seed hole prevents the seed from projecting too far through the hole; secondly, by making the hole slightly larger at the top than at the bottom, it takes the larger seeded cottons more easily; thirdly, two small radiating lines have been added as guides in obtaining the correct angle to which the wings of the halo should be combed.

The scale is graduated in millimetres. This is advocated by Mr. Bailey because no close relation exists between the halo length as measured on the scale, and the staple length as estimated by brokers; and by measuring the halo in millimetres, while the staple is given in sixteenths of an inch, there is less likelihood of a comparison being drawn between them.

The graduations are in red, as this colour can easily be seen against black velvet and also shows up well against the cotton.

If any reader wishes to obtain similar scales, the Corporation will be glad to supply them at cost price, namely 6s. 6d. each.

Mr. Bailey's original note is appended for convenience of reference together with photographs of the scale and of combed halos.

THE DESIRABILITY OF INTERCHANGE OF DETAILS OF METHODS EMPLOYED IN MEASURING "HALO LENGTHS" AT DIFFERENT EXPERIMENT STATIONS

By M. A. BAILEY, *Sudan.*

"Halo length" must always be a factor of very great importance in cotton-breeding, and its accurate determination is an essential part of the routine work of any station engaged in such work.

It is doubtful if any two workers employ exactly the same method of measurement.

This is not a matter of much importance until interchange of pure-line types takes place between different countries, when an opportunity arises of studying the effect produced by complete change of environment.

The ideal arrangement would be for all workers to adopt the same method of measurement from now on, but it would be difficult to obtain agreement, even between individual members of the Empire Cotton Growing Corporation, let alone between those in other organizations and countries.

The next best thing is that each Experiment Station should put on record an exact description of the method employed at that station, and it is suggested that this should be done in the case of all stations maintained or partly maintained by Corporation funds.

With this object in view I have appended to this note a complete copy of the actual detailed instructions for carrying out this work issued to the staff of the Plant Breeding Section of the Sudan Department of Agriculture:—

METHOD EMPLOYED IN MEASURING COTTON HALO LENGTHS.

1. *Combing* will be carried out so as to form a halo of the shape indicated in the accompanying Photograph (A), the hairs being combed away from the pointed end of the seed. The angle formed by the wings with the longitudinal axis of the seed should be 130°. Great care must be taken in combing to distribute the hairs evenly in a direction at right angles to the surface of the seed and to avoid breaking or pulling out the hairs as far as possible. When combing out the *ends* of hairs always hold the portion of the hairs nearest the seed firmly between the fingers to reduce the risk of pulling off the hairs.

A xylonite comb with fairly fine and very smooth teeth, not too pointed, will be used.

2. The *special transparent celluloid measurer will always be used* for measuring halos, Photograph B. The graduations are in millimetres, the circles being 10 mm. apart.

(*a*) Lay the measurer over the halo and press down lightly, at the same time pulling it towards you very lightly in order to straighten out the hairs.

Do not force the seed more than halfway through the opening, and do not drag the seed when straightening the hairs.

(*b*) Measure to where you can detect a distinct edge to the halo. Outside this edge there are generally a few odd hairs, usually but not always twisted, which are, actually, not attached to the seed but have been loosened but not entirely combed out.

(*c*) Look first along the radial lines B, C, and D (see accompanying sketch), note mentally the length of the halo at each of these points. Make a mental *average* of these three readings.

Now look along the two lines A and E.

The halo length at these places will almost always be somewhat shorter. Make a *mental average* of the two readings at A and E.

Find out how much less the average at A, E is than the average at B, C, D.

Divide the difference which you find by 5 and subtract the result from the average which you had previously obtained at B, C, D.

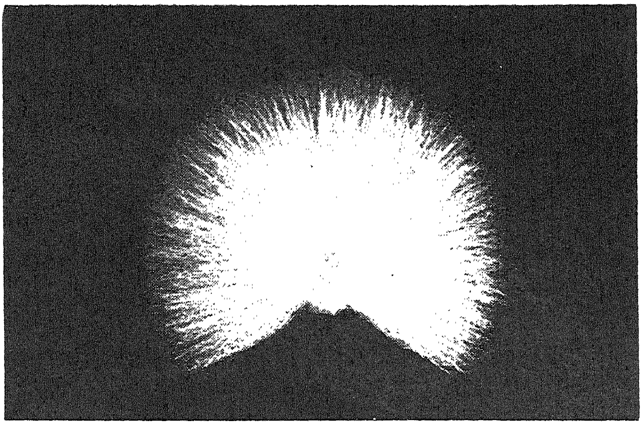
EXAMPLE.

Measurement at B	=	36 mms.
" at C	=	34 mms.
" at D	=	35 mms.
Average at B, C, D	=	35 *mms.*
Measurement at A	=	31 mms.
" at E	=	29 mms.
Average at A, E	=	30 mms.

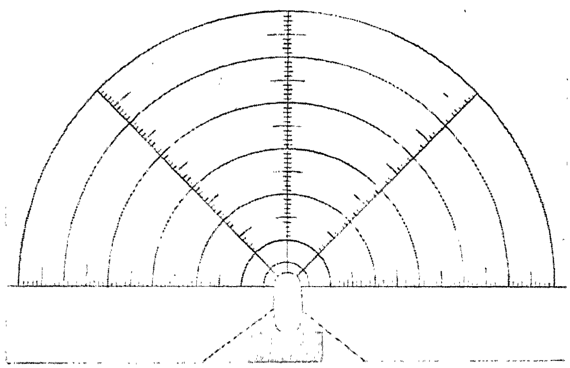
Difference between the two averages = 5 mms.

Difference divided by $5 = 5 \div 5 = 1$.

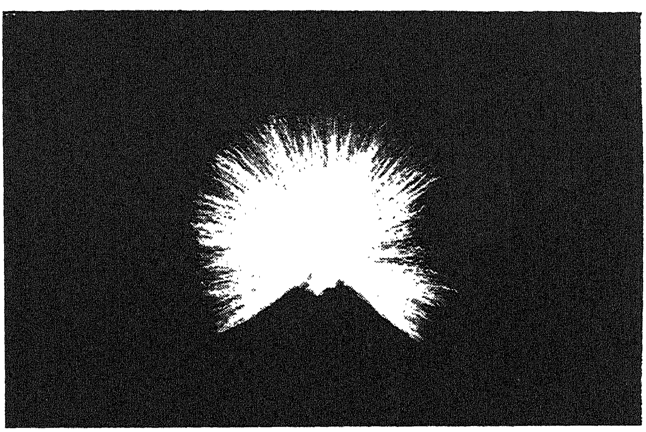
Hence correct average for halo $= 35 - 1 = 34$ mms.



A.—Halo Combed Out ready for Measurement.

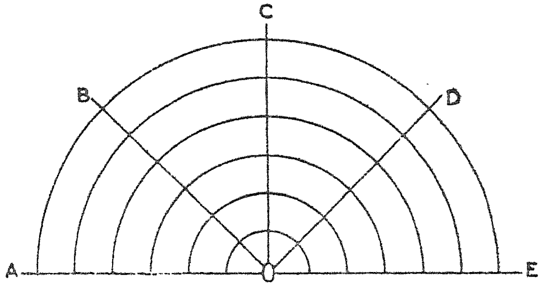


B.—Transparent Celluloid Measurer (for Halo Measurement).



C.—Badly Combed Seed with Portion of Halo Pulled Out.

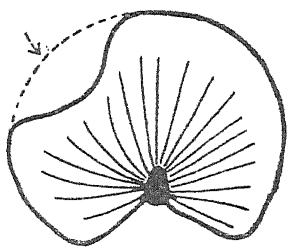
If the correction comes out at 1/5th only it will be neglected. 2/5ths or 3/5ths will be regarded as " $\frac{1}{2}$ " when subtracting, and 4/5ths will be taken as equivalent to a whole millimetre.



With practice it becomes quite unnecessary to do more than make a mental average of the reading at B, C, and D, and to *estimate* (without doing any sum) how much should be deducted from this average to allow for shortness at A and E.

3. In certain cases the combers pull out whole tufts of lint by mistake and try to cover up what they have done by combing the adjoining hairs across into the space made.

Such halos look as if they had had a piece bitten out (see Photograph C.). When measuring such a halo, allowance must be made for the bit which has been lost, the measure being taken to where the halo edge would probably have reached.



BUSH PATHS AND ROADS IN NIGERIA

BY

Rev. SIDNEY R. SMITH, Ph.D.
Formerly Archdeacon on the Niger.

It is sometimes asserted that it is possible to travel from the Atlantic right across Africa to the Indian Ocean by means of paths leading from one town or village to another. Like all generalizations, this may be true of the region lying a few degrees north or south of the Equator, if allowance is made for the waterways which play an important part as a means of communication.

In the Southern Provinces of Nigeria, before the Government assumed control, there were practically no roads save what are generally known as bush paths, and though conditions have altered, and are altering, with startling rapidity, there are still a few of the remoter areas where the bush path still holds its own.

First of all it is well to remove a misconception as to the function of a bush path. The object of a road as we understand it is to get "there," wherever "there" may be, as directly and as quickly as possible. But the object of a bush path is much more subtle than that. While it will take those who understand it where they want to go, it is intended to deceive and lead away from the village all evilly-disposed persons or malignant spirits who seek to carry out their evil designs upon the people and their farms. So "medicine" is put across the path to kill the enemy, and sacrifices and food offerings are made to propitiate the spirits, and the path is carried round the "badbush" and the sacred groves of trees, as though calling upon the spirits that dwell in them to protect their children.

The bush path generally consists of a track just wide enough for people to walk in single file, a habit which is so deeply ingrained that it is followed instinctively even when the road is wide. It is made by cutting down the bush and long grass and by digging the earth from the centre of the track to each side with short hoes. The result is that on a slope the path becomes a V-shaped water channel, and on the level, very often a bed of soft deep sand, very tiring to the feet of the traveller. When the grass grew up an early morning walk involved a thorough soaking by the heavy dew, but

this did not trouble very much people with bare feet and legs and only a short loin cloth. If a tree, torn up by the roots by a tornado, fell across the path, it remained there until it disappeared by the processes of decay or fire, and the path which was carried round its prostrate form alone remained to bear witness to the fact by its irritating tortuosity.

The best bush paths very naturally were those linking up the markets of friendly groups of towns and villages. The week consisted of four days, upon each of which a market would be held in the morning somewhere in the group, and often a second one in the afternoon. In spite of the need for keeping the paths clean in the interests of the market people, it usually happened that no steps were taken until they had become almost impassable.

In some areas the village of a town which was responsible for the upkeep of the path was usually situated on the outskirts of the town through which the market people had to pass. When the need for cleaning the path had been recognized sufficiently, the head chief of the village sent round one of his men at night to call out the age-class of young men capable of hard work on the following morning. The messenger carried an iron gong which he beat with a stick by way of calling attention to the notice which followed immediately to this effect: "Tomorrow morning at daybreak all young men are to take their matchets and hoes to the market path and to proceed at once to clear away the grass, anyone failing to turn up will be fined one bag of cowries" (or other penalty varied according to the humour of the crier). There was something indescribably weird on a still night, when everyone was thinking of sleep, in the sound of the sharp but not unmusical summons of the gong and of the high-toned rhythmic chant conveying the order, ending up with a long-drawn-out "O-O-O," which gradually died away.

The next morning at daybreak came the young men to the appointed place carrying their matchets or cutlasses and short J-shaped handled wooden hoes with oval iron blades. The old men who were past work turned out with boys carrying their stools (from which to sit and watch the workers by way of encouragement), and pots of palm wine for general refreshment. A drummer appeared, and, following the rhythm, hands and feet and bodies were soon moving as one man in the work of clearing the path, amid a cloud of dust which enveloped them all. In order to encourage the workers a yodeller would also be brought in who could yodel by the hour without appearing to get tired.

At midday the work was at its height, and passers by saluted the

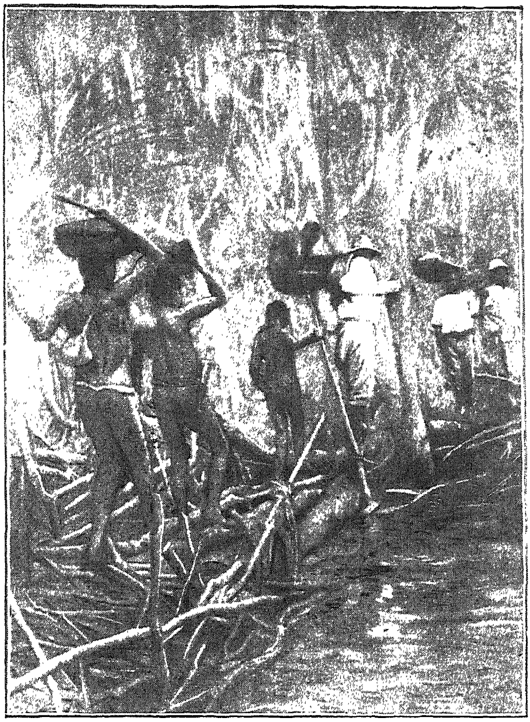
young men in acknowledgment of their services. Occasionally a man would break away with a wild rush and strike matchets with another, yelling and posturing as if he had killed some notable enemy or wild beast. When the work was done the young men would go off together to the homes of the defaulters and lay hands on anything available, such as cooking pots, axes, and fowls, to be redeemed later on payment of a fine. This was an excellent and effective method of bringing home to slackers communal obligations.

On the following market day a light barrier of palm branches was placed across the newly cleaned path, and representatives of the village stood by the narrow aperture in the barrier and received toll, consisting of cowries or leaves of tobacco, from everyone going to market. The place selected was generally near to some sacred tree or grove where sacrifices were made, and thus a kind of sacred sanction was imparted to the demand for toll.

When the grass on each side of the path was kept low, opportunity was given for the growth of a profusion of wild flowers. Among them might be seen the convolvulus in several varieties, the yellow coreopsis in great abundance, and a pea with a brilliant blue flower. Climbing up the shorter scrub in rich luxuriance appeared that most beautiful of all lilies, the *Gloriosa superba*, with its bright green leaves furnished with prehensile tendrils, and large yellow and green and scarlet striped reflexed petals, each flower differing in its coloration according to the stage of maturity it had reached. These flowers were a perpetual delight to me, but to the people they were no more than grass, and only occasionally would they show any appreciation of them. To anyone picking flowers the question would be addressed, " Are you going to eat them ?"

If the bush path was badly kept, and elephant grass and other tall grass with razor-edged leaves shut out the light and air, nothing could be more unpleasant and trying than walking in the heat of the day, and sinking in loose sand at every step. When a walk was taken just before sunset along the path, the goatsucker—a kind of night-jar, with a 7 or 8 inch feather, bare except for the tip, and jointed on to each wing—would suddenly spring up from beneath one's feet with the two feathers trailing behind. One had also to be careful to avoid treading on the line of a battalion of driver ants on some raiding expedition, or disturbing the nests of the amber-coloured tree ants. When they could not be avoided, there was nothing for it but to strip and get someone to help remove from your body the resentful insects.

On reaching a town or village the bush path lost its identity,



Crossing the River Ide-mili between Obusi and Awba.

A Native Road over a Swamp.

when a P.W.D. engineer was replacing a rough native bridge by one made of ferro-concrete. The river with its fish was regarded as sacred by many towns on its banks, and the people confidently expected disaster because of this quasi-sacrilege, as they watched the deflection of the main current and the disappearance of tons of cement apparently to no purpose.

But their amazement was unbounded when they saw the triumph of mind over matter, and the bridge slowly emerge and in course of time carry heavy traffic. Their faith in what till then had been an object of fear and worship has probably not been the same since that victory.

Modern Roads.—To Sir Walter Egerton, the first Governor of the United Colony and Protectorate of Southern Nigeria, the credit is due for the wise policy of settling the country and opening it up, not with military expeditions so much as by the making of fine trunk roads throughout the hitherto closed country in the east as well as the more or less open country in the west. By his direction the roads were planted on each side with trees, including flamboyants, African cedars, and other indigenous trees which afforded shade. To-day there are hundreds of miles of road planted in this way, affording grateful shade to the traveller at all times in the day. Some towns went to the length of planting bananas in the holes alongside the road from which the clay for the road-making had been dug.

Before the making of many roads came the survey for the telegraph, and it is not an exaggeration to say that the cutting of the traces through the bush direct from point to point, by gangs of men working under keen, enthusiastic Sapper officers, and in due course the erection of iron telegraph poles in a dead straight line, established for the first time in the history of the people a standard of straightness and some notion of a straight line. Today a good and straight road is called in several African languages a "wire" road.

The first roads were made without metal, and consisted of earthworks graded and levelled, the surface being sprinkled with water and beaten with long, flat, curved mallets. The top loam was removed and the red clay dug from pits along the roads in making, and carried in baskets on men's heads to the track. The sprinkling with the water was often effected by filling the mouth with water and squirting it over the clay to be beaten. This method of road-making was in accordance with native methods, for they had been accustomed in the old fighting days to erect miles of massive earthworks which stood the rains of years, and many of the men were artists in working with clay.

Later on, in areas where there was not a stone to be found for miles, a substitute was found in the hills of the so-called white ants. These mushroom-shaped heaps were collected and stacked along the tracks, and then put on to the road and broken up by hand or by rollers made with concrete. The adhesive juices used by the ants in mixing the clay prevented it from becoming mud, and made it an excellent substitute for metal for a short time, until it was ground to powder.

The surface of the beaten road without metal was wonderfully effective, but heavy motor traffic caused undulations which were anything but pleasant. Most of the roads have now been metalled to a depth of about 3 inches, or more where stone is abundant, and attempts from time to time have been made to bind the surface of the roads together by planting bahama grass.

Great difficulties were at first experienced with the construction of culverts on account of the rush of water following rain, which on occasions registered 4 inches in one hour. Cement culverts were replaced by circular tubes of corrugated iron riveted together, and these, augmented by concrete approaches, have proved very useful.

Carriers do not like the new roads, and they are often compelled to bind up their feet with rags to protect them from the burning heat of the hard surface.

In the early days of the new trunk roads one of the difficulties was the protection of travellers. Yoruba and Hausa traders disappeared completely with all their goods and no traces were left. Teachers proceeding to take up appointments in out-stations were attacked, and some never reached their destination. There was one place on the Onitsha-Owerri road which had a very bad reputation, and many weary travellers were beguiled into accepting proffered hospitality only to be murdered and their bodies cut up for food. The trouble was to some extent stopped by making the head chiefs of towns along the road responsible for the safety of definite sections of the road in their vicinity.

Things have changed since those days, and now motor-cars and lorries rush along these roads laden with passengers and goods. How so many people can crowd into one lorry with their loads is always a mystery, but that some of them ever arrive at their destination is a greater mystery still. But Nigerian motor drivers seem to have come to some understanding with the Ford engine, for it responds to their treatment in an unaccountable way. They say "the motor is a spirit," and perhaps some of them believe it. It is a fact,

however, that with a few weeks' training many Nigerian young men utterly ignorant of machinery were trained as motor drivers and proceeded to "German East," where they played a very useful part in that campaign, from which many never returned.

In conclusion, I think that when the history of Nigeria comes to be written it will be found that one of the most important factors in the development of the country was the making of trunk roads and bridges.

These roads have opened up areas once closed by tribal feuds, or jealously guarded from foreign interference lest the monopoly in slavery and "oracles" should be undermined. They have already begun the process of the unification of the dialects in each great language group, which is always brought about by the contact of travellers with other people.

Like a flood has come in the mad rush of civilization, with its passion for speed and the tendency to confound movement with progress, and one wonders whether the evils of civilization coming thus in contact with primitive peoples do not outweigh the benefits. In the slower days when Government officials, traders, and missionaries travelled on foot or by bicycle, personal contacts with the people were established which were of the greatest value to all alike. It was laborious and exhausting, but it was more in harmony with the country and the mentality of the people, who above all things hate to be hustled.

It is, I suppose, inevitable that the bush path should be superseded by the graded metalled motor road, but I cannot help feeling that while admittedly much has been gained, yet something of value has been lost in the process.

Received May, 1931.

COTTON STATISTICS

INDIA

BY

JOHN A. TODD, M.A., B.L.

In this issue we give the usual tables dealing with the season's history of the Indian crop. In former years we also gave at this stage a table of the Smaller World's Crops, but, as these are now included in considerable detail in the table of the World's Crops given in the April issue, it is no longer necessary to give the separate table.

With regard to India the figures of the 1930-31 crop are again very disappointing; in fact, the feature of the whole position with regard to India is the consistently disappointing yield of recent years. As will be seen from Table I., the 1930 crop shows the smallest acreage since 1922 and the smallest crop since 1921. The total is only 4,820,000 bales against the record of 6,215,000 in 1925-26; and the average yield is also very low, 82 lbs. per acre against the record of 99 lbs. in 1919.

There are, however, an unusual number of qualifications to note with regard to the figures. In the first place, comparisons with last year are modified by the severe downward revision which the 1929-30 crop has now undergone; this brought the yield for that year down to 79 lbs. per acre, which makes it the lowest since 1920. Thus on the figures as they stand at present this year's average yield is a slight improvement on last year, but the small acreage makes a lower crop figure. An examination of Table IV., giving the details of the acreage and crop by Provinces, shows where the falling off has been heaviest. Of the larger provinces Madras, Bombay, and Central Provinces show the heaviest reductions in acreage, while in average yield Madras and Hyderabad are the worst sufferers.

It must be remembered, however, that the Government estimates are not the only crop figures. We have also to consider the commercial crop, details of which are given in Table II. Here we find that the estimated commercial crop for 1929-30 is actually the largest on record, 6,991,000 bales, so that the excess over the Government estimate is very heavy; in fact, the percentage of discrepancy, 36·4, has only twice been exceeded. This persistent difference between the two sets of figures is very inconvenient; and it is not merely

due to differences of carry-over at the end of the season, because the total of the commercial crops for 1914-1929 is actually about 7 per cent. more than the total of the Government estimates.

In view of the very heavy world consumption of Indian cotton in recent years, it is to be regretted that there are no complete statistics available for a World's Carry-over of Indian cotton, but, judging from what evidence is available, it seems clear that stocks must have been substantially depleted during the past season.

As regards the distribution between long and short staple varieties, it appears that the percentage of long staple varieties this year is the smallest (both in area and crop) since these figures were first published in 1924-25, while the average yield for the longer stapled varieties is also a low record. The loss seems to be mostly in the southern varieties, but it is satisfactory to note that the figures for the Punjab show a marked improvement on recent years. The details are given in Table III. With regard to this table we have again to note that the Government in their revision of back years have carried back the revision of the crop by Provinces for two years, including 1928-29, whereas the revision by Varieties has only been carried back to 1929-30. The result is that, as has happened before, the total crop given for 1928-29 in Table III. does not tally with that given in Tables I. and IV.

The table of the other Empire crops which follows the Indian tables is compiled by the Empire Cotton Growing Corporation.

TABLE I.—INDIAN CROP, AREA, YIELD, AND PRICE, 1914–1930.

Seasons.	*Area (Acres).* 000's.	*Crop (Bales of 400 Lbs.).* 000's.	*Yield per Acre. (Lbs.)*	*Net Exports and Consumption.* 000's.	*Season's Average Prices.*	
					No. 1 Fine Oomra.	*Per Cent. on American.*
1914–15 ..	24,595	5,209	85	4,889	4·46	85
1915–16 ..	17,746	3,738	84	5,109	6·09	81
1916–17 ..	21,745	4,489	83	4,985	10·32	84
1917–18 ..	25,188	4,000	64	4,499	18·78	87
1918–19 ..	20,997	3,972	76	3,991	18·13	92
1919–20 ..	23,352	5,796	99	5,343	19·23	76
1920–21 ..	21,340	3,600	67	4,941	9·20	77
1921–22 ..	18,451	4,485	97	5,972	9·60	85
1922–23 ..	21,804	5,073	93	6,270	11·14	75
1923–24 ..	23,631	5,161	87	5,946	13·35	74
1924–25 ..	26,801	6,088	91	6,923	11·95	87
1925–26 ..	28,403	6,215	88	6,508	8·97	83
1926–27 ..	24,822	5,024	81	5 624	7·18	88
1927–28 ..	24,761	5,963	96	5,661	9·21	83
1928–29 ..	27,053	5,782	85	6,675	8·03	76
1929-30 ..	25,922	5,125	79	6,991	6·39	70
1930–31 ..	23,616	4,820	82	—	—	—

TABLE II.—INDIAN "COMMERCIAL" CROP.

(RUNNING BALES 000's.)

Seasons.	*Net Exports.*	*Mill Consumption.*	*Domestic Consumption.*	*Total.*	*Discrepancy from Government Estimate Per Cent.*
1914-15 ..	2,118	1,771	1,000	4,889	- 6·2
1915-16 ..	2,486	1,873	750	5,109	+36·8
1916-17 ..	2,081	2,154	750	4,985	+11·0
1917-18 ..	1,705	2,044	750	4,499	+12·5
1918-19 ..	1,238	2,003	750	3,991	+ 0·5
1919-20 ..	2,680	1,913	750	5,343	- 7·8
1920-21 ..	2,113	2,078	750	4,941	+37·2
1921-22 ..	3,063	2,159	750	5,972	+33·2
1922-23 ..	3,411	2,109	750	6,270	+23·6
1923-24 ..	3,350	1,846	750	5,946*	+15·2
1924-25 ..	3,998	2,175	750	6,923	+13·7
1925-26 ..	3,775	1,983	750	6,508	+ 4·7
1926-27 ..	2,830	2,044	750	5,624	+11·9
1927-28 ..	3,140	1,771	750	5,661	- 5·1
1928-29 ..	3,933	1,992	750	6,675	+15·4
1929-30 ..	3,868	2,373	750	6,991	+36·4

* Up till 1923-24 the imports were deducted, because some of the mills in the Native States included foreign cotton in their consumption.

TABLE III.—INDIAN COTTON CROP: AREA, CROP, AND YIELD PER ACRE *BY VARIETIES.*

Varieties.	1927–28.			1928–29.			1929–30.			1930–31.		
	Area (Acres).	*Crop (Bales).*	*Yield per Acre (Lbs.).*	*Area (Acres).*	*Crop (Bales).*	*Yield per Acre (Lbs.).*	*Area (Acres).*	*Crop (Bales).*	*Yield per Acre (Lbs.).*	*Area (Acres).*	*Crop (Bales).*	*Yield per Acre (Lbs.).*
I. *Mainly under $\frac{7}{8}$ Inch Staple:*												
Oomra (Khandeish, Central India, Berar, and Central Provinces) ..	8,096	1,891	94	8,420	2,031	96	8,569	1,683	81	7,900	1,659	84
Dhollera	3,072	858	112	3,094	402	52	2,807	509	73	2,445	491	80
Bengal Sind (United Provinces, Rajputana, Sind, Punjab, etc.) ..	2,782	782	112	3,586	1,020	114	3,604	977	108	3,347	988	118
Comilla, Burma, etc.	470	104	89	460	92	80	467	104	89	502	123	98
Coconada	214	39	73	236	46	78	259	45	69	196	32	65
Total under $\frac{7}{8}$ inch staple ..	14,634	3,674	100	15,796	3,591	91	15,706	3,318	85	14,390	3,293	92
Per cent. of total crop	59·1	61·6	—	58·4	61·8	—	60·6	64·7	—	60·9	68·3	—
II. *Mainly $\frac{7}{8}$ Inch Staple and Above:*												
Punjab (American)	750	219	117	974	189	78	806	248	123	836	270	129
Sind (American)	15	3	80	29	6	83	27	8	119	65	20	123
Broach	1,274	244	77	1,270	209	66	1,324	284	86	1,092	227	83
Coompta Dharwar	1,726	327	76	1,945	303	62	1,746	284	65	1,398	192	55
Western and Northern	1,534	221	58	1,835	349	76	1,551	72	44	1,558	163	42
Tinnevelly	568	148	104	610	163	107	601	162	108	517	133	103
Salem	181	34	75	224	43	77	221	38	69	188	33	70
Cambodia	287	123	171	384	146	152	395	144	146	298	113	152
Barsi and Nagar }	3,792	970	102	3,986	812	81	2,629	341	52	2,303	262	46
Hyderabad Gaorani }							916	126	55	971	114	47
Total $\frac{7}{8}$ inch staple and above ..	10,127	2,289	90	11,257	2,220	79	10,216	1,807	71	9,226	1,527	66
Per cent. of total crop	40·9	38·4	—	41·6	38·2	—	39·4	35·3	—	39·1	31·7	—
Grand total	24,761	5,963	96	27,053	5,811	86	25,922	5,125	79	23,616	4,820	82

000's omitted throughout in area and crop figures.

TABLE IV.—INDIAN COTTON CROP: AREA, CROP, AND YIELD PER ACRE *BY PROVINCES.*

	1926–27.			1927–28.			1928–29.			1929–30.			1930–31.		
	Area (Acres).	*Crop (Bales).*	*Yield per Acre (Lbs.).*	*Area (Acres).*	*Crop (Bales).*	*Yield per Acre (Lbs.).*	*Area (Acres).*	*Crop (Bales).*	*Yield per Acre (Lbs.).*	*Area (Acres).*	*Crop (Bales).*	*Yield per Acre (Lbs.)*	*Area (Acres).*	*Crop (Bales).*	*Yield per Acre (Lbs.).*
Madras	2,231	388	70	2,123	447	84	2,495	528	85	2,507	513	82	2,117	417	79
Mysore	97	25	103	81	25	123	76	23	121	69	9	52	72	10	56
Hyderabad	3,267	808	99	3,631	951	105	4,019	895	89	3,536	447	51	3,527	382	43
Bombay*	6,918	1,290	75	7,765	1,802	93	8,048	1,447	72	7,297	1,309	72	6,046	1,190	79
Baroda	761	124	65	806	124	62	793	69	35	771	127	66	731	140	77
Central Provinces and Berar	4,864	977	80	4,796	1,235	103	5,078	1,334	105	5,175	1,143	88	4,787	1,062	89
Central India ..	1,297	223	69	1,263	234	74	1,287	252	78	1,388	202	58	1,284	205	64
Gwalior	649	107	66	585	115	79	645	107	66	633	89	56	619	103	67
Bengal	77	25	130	78	20	103	79	18	91	78	21	108	77	19	99
Bihar and Orissa ..	79	14	71	77	14	73	78	14	72	69	13	75	69	14	81
United Provinces ..	809	258	128	643	199	124	715	255	143	929	289	124	843	321	152
Rajputana	404	78	77	422	97	92	476	123	103	507	67	53	510	73	57
Ajmer Merwara ..	43	15	140	42	14	133	44	21	191	34	11	129	31	11	142
Punjab	2,803	599	85	2,068	602	117	2,841	619	87	2,536	799	126	2,491	768	123
North-West Frontier..	30	5	67	10	2	73	17	4	94	17	4	94	13	3	92
Assam	46	15	130	45	15	133	44	17	155	41	15	146	41	15	146
Burma	447	73	65	326	67	82	318	56	70	335	67	80	358	87	97
Total	24,822	5,024	81	24,761	5,963	96	27,053	5,782	85	25,922	5,125	79	23,616	4,820	82

* Including Native States, also Sind and Delhi. 000's omitted throughout in area and crop figures.

EMPIRE COTTON CROPS FOR THE YEARS 1920–30, EXCLUDING INDIA.

(*In bales of 400 lbs.*)

The seasons are given as covering *two years* (*e.g.*, 1926–1927) because in the majority of the countries named planting takes place in one calendar year and *picking in the next*. In a few of these countries, however (*e.g.*, Tanganyika, Iraq, Cyprus, Malta and some of the West Indian Islands), the crop is harvested in the same year as that in which it is planted. In such cases the figures should be read as relating to the crop grown and harvested in the *latter* of the two years at the head of the column.

Country.	1919–20.	1920–21.	1921–22.	1922–23.	1923–24.	1924–25.	1925–26.	1926–27.	1927–28.	1928–29.	1929–30.	
(1) Anglo - Egyptian Sudan	23,160	30,519	24,074	28,306	47,652	44,912	121,131	148,118	126,115	161,536	157,769	(1)
(2) Gold Coast ..	—	61	49	15	93	1,132	1,218	285	264	296	200	(2)
(3) Nigeria ..	16,200	30,000	15,096	16,811	25,694	39,137	47,909	27,464	20,930	32,126	43,925	(3)
(4) Uganda ..	47,694	81,365	48,290	88,046	128,604	196,038	180,859	131,728	138,486	204,057	129,969	(4)
(5) Kenya ..	100	500	417	1,200	1,653	2,250	2,046	1,232	1,241	1,984	1.518	(5)
(6) Nyasaland ..	2,026	4,615	5,422	4,036	6,873	7,718	4,976	2,792	4,470	6,095	9,331	(6)
(7) N. Rhodesia..	35	100	80	102	500	379	506	32	17	—	—	(7)
(8) S. Rhodesia ..	—	—	—	—	1,650	4,907	6,803	639	90	280	1,481	(8)
(9) Tanganyika ..	—	7,327	7,175	11,434	18,793	21,724	24,280	15,966	32,954	27,785	22,813	(9)
(10) Union of South Africa and Swaziland	2,737	2,923	2,740	6,523	8,730	16,936	20,381	10,242	11,013	9,774	16,213	(10)
(11) West Indies ..	5,787	4,763	4,314	5,295	4,309	4,186	5,941	6,076	4,088	5,312	5,677	(11)
(12) Queensland ..	38	792	3,140	9,344	11,850	14,318	7,179	5,880	10,266	6,296	12,754	(12)
(13) Cyprus ..	2,687	2,547	1,505	2,233	3,397	3,320	4,614	2,110	2,146	3,610	4,778	(13)
(14) Malta ..	266	582	193	118	573	782	507	342	541	379	293	(14)
(15) Iraq	60	60	300	1,100	2,400	2,540	3,500	1,800	5,200	4,700	3,300	(15)
(16) Fiji	—	—	—	85	157	123	824	356	114	271	500	(16)
(17) Ceylon ..	—	—	—	49	324	121	261	186	202	380	248	(17)
	100,790	166,154	112,795	174,697	263,252	360,523	432,935	355,248	358,137	464,881	410,819	
		Percentage Increase 64·8.	*Percentage Decrease* 32·1.	*Percentage Increase* 54·8.	*Percentage Increase* 50·6.	*Percentage Increase* 36·9.	*Percentage Increase* 20·0.	*Percentage Decrease* 17·9.	*Percentage Increase* 0·8.	*Percentage Increase* 29·8.	*Percentage Decrease* 11·6.	

NOTES ON CURRENT LITERATURE

COTTON IN INDIA.

352. India. *A New Cotton Variety.* (*Text. Rec.*, xlviii., **575**, p. 77.) It is stated that progress has been made in the Central Provinces in the isolation of a strain of "Chanda Jari" cotton of 1 in. staple having a white lint, but the chief attraction of the day is the wilt-resistant and high-yielding cotton of good staple known as Verum 262. This variety, however, in districts having late September rains, is apt to suffer severely from boll shedding, with consequent reduction of yield; but it is hoped, at no distant date, to issue a cotton resembling Verum 262 which will flower eight to ten days later, thus reducing the risks of damage.

353. The Effect of Some Meteorological Conditions on the Growth of Punjab-American Cotton. By T. Trought. (*Mems. of Dpt. of Agr. in India*, Bot. Ser., xvii., **6**, 1931.) The climate of the Punjab is generally reviewed during the cotton-growing season and compared with that of some other cotton-growing countries. Diagrams showing the daily march of maximum and minimum air temperatures, evaporation in the cotton field, soil temperatures and the incidence of dust storms, rainfall, and irrigation during the season, are presented in comparison with the daily increase in height of Punjab-American Cotton 4 F. These diagrams are briefly discussed. There is an increase in the rate of elongation following rain and irrigation, and a temporary decrease following dust storms. A reason for the decrease following dust storms is suggested. The evaporation in the "crop's atmosphere" decreases as the crop grows and becomes fairly constant. There appears to be a connection between maximum soil temperatures at 30 cm. depth in irrigated fallow and elongation. The effects of maximum and minimum air temperatures on increase of stem elongation are found to be surprisingly small under irrigated conditions with 4 F Punjab-American cotton.

354. Agra and Oudh. *Cotton Cultivation.* (*Rpt. on Admin. of Dpt. of Agr.*, 1930, recently received.) With a view to the improvement of cotton cultivation the Department, in co-operation with the Upper India Chamber of Commerce, has decided to extend the cultivation of C. 402 in compact blocks in irrigated areas, and that of A. 19 in areas suitable for it, where cultivators wish for seed of this type.

The chief problems engaging the attention of research workers are: the improvement of the yield of the existing Bengal cottons, the extension of the cultivation of a strain suitable for spinning 20's counts, and the control of the pink bollworm.

355. Technological Reports on Standard Indian Cottons. By N. Ahmad. Copies have been received from the Indian Central Cotton Committee of reports on the cottons named below. The particulars include Agricultural Details, Grader's Report, Fibre Particulars, Spinning Tests, Remarks and Conclusions.

(1) *Umri Bani*, 1930-31. Area under cultivation, 225,000 acres under Government seed and 540,000 acres under cultivators' seed (mixed Gaorani). The 1930-31 cotton is much cleaner than its predecessors, and the improvement in yarn strength has been maintained. It is described as suitable for 28's warp.

(2) *Punjab-American* 289 *F.*, 1930-31. Area under cultivation in 1929-30 about 4,600 acres. The neppiness of this cotton has detracted from its value

hitherto, but the 1930-31 cotton shows a great improvement in this respect. It is described as suitable for 44's warp.

(3) *Punjab-American 4F.*, 1930-31. Area under cultivation in 1929-30 793,000 acres. This season's cotton is less neppy and has greater strength and evenness than that of the previous season. It is described as suitable for 22's warp.

356. Spinning Test Reports on Indian Cottons. By N. Ahmad. (*Indian Cent. Cot. Comm. Tech. Circs.*, Nos. 39, 40, 44, 46-48, 1931.) The circulars contain the grader's report and spinning test results for Khandesh, Ujjain, C.P. No. 1, Muttia, Berar, New Broach, Jagadia, Bawla, Kadi, Hubli Kumpta and Hubli Upland cottons for the 1930-31 season.

COTTON IN THE EMPIRE (EXCLUDING INDIA).

357. The following reports have recently been received:

Report of Imp. Coll. of Sci. and Tech., 1930.

Report of Imperial Institute, 1930.

Report of Sci. and Indus. Res., 1929-30.

Queensland: Ann. Rpt. of Dpt. of Agr. and Stock, 1929-30.

Tanganyika: Ann. Rpt. of Dpt. of Agr., 1929-30.

Uganda: Ann. Rpt. of Dpt. of Agr., 1929.

West Indies: *Antigua.* Rpt. of Agr. Dpt., 1929-30.

358. British Cotton Growing Association. The Twenty-sixth Annual Report contains, as usual, very interesting information. It is stated that there was a very considerable reduction in the Spot sales of American cotton in Liverpool during the year, the total being 665,100 bales, as against 996,770 bales for the previous year, a decrease of over 33 per cent. On the other hand, the Spot sales of Empire and other outside growths during the same period increased by more than 20 per cent., from 569,970 to 686,080 bales. For the first time the sales of American cotton were exceeded by those of other varieties. The increase in the consumption of Empire and miscellaneous growths is most gratifying in view of the depressed state of trade during the year, and is proof that the cotton is superior in quality and value in comparison with American. There are distinct possibilities for further development in the use of these types of cotton, which should show profitable results to spinners and manufacturers who are prepared to cater for specialized business in certain Colonies and Protectorates.

The total number of bales dealt with by the Association during the year was 89,350, of a value of £1,785,979. The work of the Association in the various countries of the Empire is described. The Report is well furnished with illustrations, and contains the usual statistical appendices.

359. "The Crown Colonist." We have received a copy of the first issue of this publication which is stated to be "A Monthly Journal of Information for all Concerned in the Trade and Development of British East and West Africa, the West Indies, Ceylon, Malaya, and the other Colonies, Protectorates, and Mandated Territories of the Empire." The Annual Subscription, payable in advance, is 12s., post free; single copies, 1s. The present number, which is excellently illustrated, contains, among others, articles on "The Colonial Empire" (Sir Edward Davson), "Colonial Development" (Sir Basil Blackett), "The Colonial Broadcasting Scheme" (Major C. F. Atkinson, B.B.C.), "Future Trend of Transport in the Colonies" (Brig.-Gen. F. D. Hammond), "Cotton Growing and Colonial Development" (R. H. Jackson).

The article of most interest to our readers will be that by Mr. R. H. Jackson,

our Chairman, which, after a general account of the growth and work of the British Cotton Growing Association and the Empire Cotton Growing Corporation concludes as follows:

" *Future Development.*—Whether it be regarded as a factor in the economic development of the Empire, or as an insurance for the maintenance of supplies of raw material for this country, the extension of cotton-growing in the Dominions and Colonies is an undertaking of first-class importance. Its economic significance is brought out by one illustration alone. The value of the exports of cotton and cotton seed exported from Uganda in 1929 was over £3,500,000. It will be realized, moreover, that such an expansion of the purchasing power of the Protectorate creates potential customers for the industries of this country.

" From the point of view of the cotton trade in this country, the output from the Empire is as yet too small to affect the world price of cotton, but its increase, and more especially the fact that the crop will be grown in many countries with different climatic conditions, thus reducing the risk of a general crop failure, should undoubtedly tend towards stability of the price, which is even more a desideratum than extreme cheapness. Moreover, during the last few years there has unquestionably been serious deterioration in the quality of the American crop, and so long as the Empire growths maintain their superiority in this respect, they will be welcome in Lancashire. As their quantity increases, they can be used to replace those types required here, which are now only forthcoming from America in markedly smaller quantities.

" Given the continuous supply of a well-trained technical staff, which in turn largely depends on the support accorded to the Imperial College of Tropical Agriculture in Trinidad, where agricultural cadets receive their post-graduate training, and given the avoidance of acute political and racial disturbances accompanied by a heavy toll on economic development, nothing can prevent continuous progress in all parts of the Empire."

360. IMPERIAL INSTITUTE. The *Ann. Rpt.*, 1930, illustrates the nature of the work carried out by the various departments of the Institute during the year. This work included investigations, or advice given, in connection with the following: silk, timbers, vegetable fibres, tung oil, hides and skins, Empire tobacco, Empire-grown products to replace foreign, new sources of products, mining law, Somaliland water, graphite from Australia, radium ore from Canada, cement-making materials, iron ore and chromite, aluminium phosphate, beryllium ore and metal.

During the year new exhibits were added to the Canadian, Indian, and South African Courts, and fifteen new panoramas were constructed in the studio and installed in the galleries. During this period also seven temporary exhibitions were held. The following comparative figures show that the work of the Institute has again been increasing:

	1930.	1929.
Intelligence Dept.—enquiries	1,937	1,729
Investigations—samples	1,261	1,022
Attendance in galleries	688,900	478,000

361. LIST OF AGRICULTURAL WORKERS IN THE BRITISH EMPIRE, 1930. (Pubd. H.M. Stat. Off., 1931. Price 1s. net.) This List has again been revised to show the names of the agricultural research workers and their investigational subjects as on June 30, 1930.

[*Cf.* Abstr. **607**, Vol. VII., of this Review.]

362. AFRICA: GAMBIA PROTECTORATE. *Cotton Cultivation.* (*Ann. Rpt. of Dpt. of Agr.*, 1929-30, p. 9.) Greater attention was devoted to cotton cultivation,

and the areas under the native variety were increased in several districts. This crop is not grown for export at present, but is used for local consumption. Comparative trials were made with Allen cotton from Nigeria and the native variety. The former proved much more susceptible to insect attack, and suffered severely from stainer injury. The native cotton also showed more resistance to the strong winds prevailing during the growing period, and owing chiefly to the conditions under which it is grown, it remains a comparatively small plant which matures early and is a prolific bearer.

363. NIGERIA. *Cotton Cultivation.* (*Half-yearly Rpt. of the Dpt. of Agr. to March* 31, 1931.) *Northern Provinces.*—The yield of American cotton is expected to be much smaller this season owing to ill-distributed rainfall, restriction of acreage caused by the low prices of last year, and by the necessity for resowing food crops ravaged by locusts. It is estimated that some 14,000 bales will be exported. This season, for the first time, jassid proved a rather serious pest, and among the cottons suffering injury was the new strain "D." Fortunately some more recent selections under trial at Samuru proved immune, and the testing and multiplication of these strains will be carried on at the Corporation's farm at Daudawa as quickly as possible.

Southern Provinces.—The Improved Ishan cotton has almost entirely replaced the native variety in the areas contributing to the export trade; 115 tons of seed were sold in 1930 as against 110 in the previous season. The lint of the Ishan A cotton is considered to be rather rough by spinners, and it is suggested that by crossing this "A" cotton with other strains of Ishan, or even with an exotic cotton of a similar type, the Plant Breeder may eventually isolate an equally hardy cotton, but with a softer lint.

364. SOUTH AFRICA. *Cotton Prospects on Lower Orange River.* (*Sun and Agr. Jour. of S. Afr.*, January, 1931, p. 19.) Mr. T. G. Hesse, the Manager of the Central Co-operative Cotton Exchange, Limited, recently reported to his Company on the cotton prospects of the Lower Orange River irrigation area, which lies between Upington and Onseepkans. This area is served by the main line running from De Aar to South-West Africa, as well as by a narrow-gauge branch line running from the junction at Upington to Kakamas, 57 miles away. The deep, fertile, alluvial soil, the hot, dry climate, together with an abundance of water, all combine to render the conditions ideal for growing a high-class strain of cotton. Mr. Hesse states that 2,000 lb. of seed cotton per acre is a very conservative estimate of the average yield of the area, since as much as 4,000 lb. per acre have been obtained. "Improved Bancroft" appears to be the sole variety grown; the cotton is very uniform, and runs from $1\frac{3}{16}$ to $1\frac{1}{4}$ in. in staple, with excellent character and strength. Last year practically all the cotton of this area went top grade of "Strict Good Middling." No ginnery exists on the spot, and this imposes considerable expense and increase in marketing charges owing to the long-distance hauls to the ginneries. If a ginnery were erected, export could be effected either through Cape Town at a distance of 761 miles from Upington, or Port Elizabeth 598 miles, as against Durban which is 1,010 miles away.

Mr. Hesse stressed the need for an experimental station to take up the matter of seed breeding, and the Minister of Agriculture has appointed Mr. D. E. A. Gutsche as a Field Husbandry Officer to organize experimental plots in co-operation with cotton-growers at various points along the river, and a small experimental station has been started at Kakamas.

365. AMERICAN COTTON GOODS: IMPORTS INTO SOUTH AFRICA. (*Text. Merc.*, 84, 1931, p. 115. Abstr. from *Summ. of Curr. Lit.*, xi., 7, 1931, p. 195.) Data relating to the South African market, compiled by the American Trade Commissioner at Johannesburg.

366. TANGANYIKA. *Cotton Industry*, 1929-30. (*Ann. Rpt. of Dept. of Agr.*, 1929-30.) *Part I.*—Notwithstanding the generally unfavourable season the production of cotton was most encouraging, the total output being 27,785 bales. The share of estate (non-native) production was recorded as 9,682 bales, or 35 per cent. of the total. In the Tabora and Bukoba Provinces cultivation is entirely by natives, and in the Mwanza Province almost entirely so. In all other areas in which cotton is grown estate production appears to be overtaking that by natives. In the sisal-growing areas a considerable amount of cotton has been grown as an interplanted crop with young sisal, a sound practice which is extending.

The surplus from the cess on seed cotton sold by natives (1 cent. per kilogramme) in the Morogoro-Kilosa area during the 1928-29 season made the levying of the cess this season unnecessary. Two cotton market supervisors were again engaged during the buying season under this fund, one being stationed at Kimamba market, and the other near the Mzinga market in the Morogoro district.

Part II.—The following experiments with cotton are described: Distance and time of sowing, and varietal trials at Morogoro Station; time of sowing, spacing, ratooning, and varietal trials at Mpanganya Station; time and distance of sowing at Ibadakuli Station.

In the trials carried out at Mpanganya it was found that the following varieties were markedly drought-resistant: Mp9, Mp13/3, Uganda 17, RM53, and Early King. The strains which suffered severely during the season—which was exceptionally dry—were Griffin, Uganda Upland, Rustenburg O, and Webber.

367. UGANDA. *Cotton Cultivation.* From the *Ann. Rpt. of the Dpt. of Agr.*, 1929, recently received, we learn that cotton planting for the 1929-30 season was delayed owing to the dry weather experienced during the greater part of June, but the weather was normal in July, and planting proceeded under favourable conditions in most districts. Abnormally heavy rains during December retarded the ripening of the crop, and blackarm disease became very active, with the result that yields were much below those of the previous season.

The Cotton Tax of 6 cents (¾d. per lb. of lint) realized £230,988 in 1929, as compared with £164,493 in 1928, when the tax was the same. The tax for 1930 was fixed at 5 cents on December 16, based on the closing price of June " futures " in Liverpool on that date.

No fresh sites for ginneries were granted during the year; 153 ginneries were licensed to gin and bale cotton, as compared with 164 in 1928.

Ploughing continued to make headway; in the Teso District 6,170 ploughs were in use, and 2,300 in Bugwere District.

The extension of the Kenya and Uganda Railway to Soroti from Tororo was opened for traffic during the year. Rapid progress was also made on the Jinja-Kampala extension, and the earthworks were completed and the rails laid to within a few miles of the River Nile. The Nile Bridge at Jinja was expected to be completed by the end of 1930.

The Cotton Botanist describes the experimental work at the Serere Experimental Station, fuller details of which are given in the Empire Cotton Growing Corporation's *Reports from Experiment Stations*, 1928-29. The Agricultural Officer describes the varietal, sowing date, spacing, and ratoon experiments carried out at the Bukalasa Experiment Station.

368. AUSTRALASIA: QUEENSLAND. *Cotton Cultivation.* (*Ann. Rpt. of Dpt. of Agr. and Stock*, 1929-30, recently received.) It is stated that the decision of the Government to guarantee an average price of 5d. per lb., and the provision of a Federal bounty for both growers and spinners, created a spirit of buoyancy early in the season, and extension of acreage naturally followed. Exceedingly variable

climatic conditions existed for the greater part of the year, however, and in consequence crop prospects fluctuated; but it is anticipated that the crop will be about 75 per cent. greater than last year, which was considered satisfactory.

The general standard of cultivation was still much below what it should have been, especially in the drier areas. Growers, however, who were thorough in their field-work demonstrated the full value of proper and therefore profitable cultivation. As a result of the heavy rainfall much of the cotton had to be put into lower grades than would otherwise have been necessary.

The work at the research station was continued. It was proved that early planting was again of decided advantage; that late summer fallowing gave most outstanding benefits; that annually sown plants of a toughened growth did not appear attractive to corn-ear worm, even if not planted early; and that crops grown on newly broken virgin soils showed less tendency to grow rankly than crops on old cultivations. Through the pure seed development work sufficient seed was obtained to plant 580 acres this season, and in addition to the development of improved strains of Durango cotton, the work of acclimatizing other varieties introduced by the Department was continued. A much greater interest was taken by growers in the varietal tests, fertilizer trials, and cultural demonstrations carried out at the research station.

During the year the cotton crop suffered appreciably from the attacks of insect pests, chief among which were Cutworms, Corn-ear Worm, Pink Bollworm, and various species of Cotton Stainer.

369. QUEENSLAND COTTON BOARD. (*Queensland Agr. J.*, xxxv., **1**, 1931, p. 72.) An Order in Council has been approved giving notice of the intention of the Governor in Council to extend the operations of the Cotton Board for a further period of five years—that is, until December 31, 1936.

370. AUSTRALIAN TEXTILE MILLS: ATMOSPHERIC CONDITIONS. By C. Badham *et al.* (*Bull. Hygiene*, **5**, 1930, p. 752. Abstr. from *J. of Text. Inst.*, xxii., **3**, 1931, A160.) Details are given of the climatic conditions of Sydney, the conditions prevailing in the textile mills, and the recommendations made for improvement.

371. WEST INDIES. *Sea Island Cotton.* (*Trop. Agriculture*, viii., **4**, 1931, p. 105.) The Sea Island cotton position is still serious, and it is suggested that if all the cotton-growing islands would combine to reduce production until surplus stocks were used up, an improvement might result in the market.

372. WEST INDIAN CONFERENCE OF AGRICULTURAL OFFICERS, 1930. We have received a copy of the Proceedings of the Conference, which was called to "devise means for co-ordinating local programmes of agricultural and veterinary research work, avoiding overlapping between Agricultural Departments of the various Colonies, and maintaining close touch between the local Departments and the Imperial College." Among the subjects dealt with at the Conference were: Canadian Trade in Fruit and Produce; Soil Research; Experimental Programmes; Cane Variety Problems.

373. WEST INDIES: ANTIGUA. *Cotton Industry.* (*Rpt. on the Agr. Dpt.*, 1929-30.) Owing to the remarkable freedom from pink bollworm excellent returns were obtained from the acreage planted in 1929, the average being over 270 lb. lint per acre. The acreage planted for the 1930 crop was approximately 815 acres, but unfortunately poor germination, heavy rains in August, followed by a drought in September, and severe attacks of cotton caterpillar coinciding with showery weather in November and December, considerably reduced the output of cotton.

374. St. Vincent. *Cotton Prospects.* A report for the quarter ended March 31 is to the effect that the yield of cotton will be good. There is little soft rot of bolls, and pink bollworm is not plentiful. The percentage of stained cotton will not be large. Cotton worms have not caused any damage, but stainers are increasing and are plentiful in one part of the island.

COTTON IN EGYPT.

375. Egypt. *New Cotton Mill.* (*Text. Rec.*, xlviii., **577**, 1931, p. 35.) It is reported that a new cotton mill has begun operations at Mehalla-Kebir. The plant has been designed with sufficient space for the installation of 1,300 looms, and it is the second unit built by the Misr Co. About 300 workpeople are now employed in the two mills.

376. Egyptian Cotton Number. (*Man. Guar. Coml.*, March 19, 1931.) In this very interesting number on Egyptian affairs, the following articles in connection with cotton are included: "The Government and Cotton," by H. E. Ahmad Wahab Pasha; "Bigger and Better Cotton Crops," by Dr. W. L. Balls; "Cotton Marketing Methods," by C. H. Brown; "Where Egyptian Cotton Scores," by M. el Darwish. The number is well furnished with illustrations.

377. Egyptian Cotton. *Resolutions adopted by the Joint Egyptian Cotton Committee at its Meeting in Cairo, January* 29, 1931. (*Int. Cot. Bull.*, ix., **35**, 1931, p. 387.) These resolutions were concerned with the Mixing of Varieties, Government Cotton Policy, Sale of Government Cotton Stocks, Standardization of Types, Extending Use of Egyptian Cotton, Foreign Matter in and Humidity in Egyptian Cotton.

378. Egyptian Cotton: Memorandum on the Bases of a Stable Cotton Policy. By H. E. Wahab Pasha. (*Int. Cot. Bull.*, ix., **34**, 1931, p. 231.) A very exhaustive statement dealing with the subject under the following main heads: The Agricultural Problem; The Financial Aspect of Cotton Policy; Cotton Policy in Relation to Commerce and Economics; Suggested Standard Types of Cotton; Intervention of the Government.

379. The Effects of Topping Egyptian Cotton Plants. By J. Templeton. (*Tech. and Sci. Serv. Bull. No.* 103, Min. of Agr., Egypt, 1931.) Experiments on topping Egyptian cotton plants (var. Zagora) are described, and effects on branching and yield are recorded. Topping at the seedling stage resulted in the production of monopodia in the axils of the cotyledons. In general, each seedling produced two monopodia, one in the axil of each cotyledon. One monopodium—that in the axil of the larger cotyledon—was invariably bigger than the other. The cotyledons increased abnormally in area and thickness, and persisted much longer than is normal. Flowering started later than with the controls. Topping before the plants had started to produce sympodia resulted in the production of several monopodia—in general, one in the axil of each of the three or four leaves carried by the stem at this time. Flowering, as expected, was again later in starting than in the case of the controls. The most marked effects of topping plants which had sympodia were the vigorous growth and branching of these. They also assumed a more erect position than normal, and their leaves became abnormally large and dark green in colour. Fasciation of branches of the sympodia was not uncommon. Flowering started with the controls, but there was a break in the flowering curve, which break occurred at progressively later dates according to the number of sympodia on the plants at the time of topping. Chequer plot experiments were carried out in which plants were topped at intervals of three weeks from April 7 till July 18. Starting with the earliest toppings the yield, compared with controls, fell off rapidly, then started to rise gradually with the

later toppings, but in no case did the topped plants yield as much as the controls. The effect of still later toppings could only have been to allow the plants to reach the yield of the controls.

COTTON IN THE UNITED STATES.

380. Domination of American Cotton Threatened. By A. H. Garside. (*Int. Cot. Bull.*, ix., **35**, 1931, p. 351.) An authoritative article on the subject, containing statistics of the relative growth in the last two decades of American and outside cottons, and pointing out the great increase in production that has taken place in foreign countries.

381. The Struggle for the World's Cotton Markets. By W. L. Clayton. (*Int. Cot. Bull.*, ix., **35**, 1931, p. 345.) A good and enlightened summary of the past history of cotton in America, the present position, and the problem of the future.

382. American Cotton Industry: Improvement. (*Text. Rec.*, xlviii., **577**, 1931, p. 25.) The President of the Cotton Textile Institute, Mr. G. A. Sloan, at a recent meeting of the New York Cotton Exchange, stated that there had been a pronounced improvement in the consumption of cotton goods and in the expansion of new uses for cotton during the past two months. Notwithstanding this gratifying expansion of business, the mills are taking a conservative attitude regarding production because of the conviction throughout the industry that the recent favourable trend in cotton textiles should not be regarded as a genuine recovery until the general business situation shows further improvement. The excess capacity for production of cotton goods has been corrected to an important extent by the discontinuance of night employment of women and minors in a large proportion of the mills.

Among the new uses for cotton goods described by Mr. Sloan is the insertion of a heavy layer of waterproof cotton fabric between two layers of wood planking in the holds of motor boats and light cruisers, which does away with the necessity of caulking. Open-meshed cotton bags are being used for the retail distribution of oranges; cotton cloth is being used for stationery, maps, menu cards, and advertising posters.

383. American Spinners' Convention, 1931. (*Text. Weekly*, **6**, 1931, p. 534. Abstr. from *Summ. of Curr. Lit.*, xi., **7**, 1931, p. 195.) The broad aspects of the scheme and its effect in practice are discussed, and a few weaknesses are pointed out.

384. One Variety Cotton Communities. (*Int. Cot. Bull.*, ix., **34**, 1931, p. 222.) With a view to improving the staple of American cotton, Mr. C. O. Moser, Vice-President of the American Cotton Co-operative Association, has outlined plans under which at least one centre of pure seed production will be established in each state of the cotton belt next year.

385. Weather and Cotton Production. By J. B. Kincer. (*U.S. Mo. Weather Rev.*, lviii., **5**, 1930, p. 190. Abstr. from *Exp. Sta. Rec.*, lxiii., **9**, 1930, p. 808.) This article, supplementing one previously noted, reports further study of the relation of weather to cotton yields and boll weevil activity in the cotton-growing area of the United States during the period 1909-1928.

[*Cf.* Abstr. **397**, Vol. VI. of this Review.]

386. Alabama. *Cotton Experiments*, 1929. By R. Y. Bailey *et al.* (*Alabama Sta. Rpt.*, 1929. Abstr. from *Exp. Sta. Rec.*, lxiv., **4**, 1931, p. 333.) During four years cotton, after vetch turned under March 25, April 5 and 15, made its highest yields after that turned under March 25. The relative returns after vetch and

sodium nitrate are compared. Seed cotton yields differed little with ammonium sulphate and sodium nitrate on limed areas, whereas without lime sodium nitrate resulted in much better yields. Superphosphate used with winter legumes caused substantial increases in the yields of cotton following, evidently by stimulating the growth of the legume. More seed cotton was obtained by supplying two-thirds of the superphosphate and potash to the winter legumes and one-third to the cotton than by giving all to the legume.

387. ARIZONA. *Field Experiments with Cotton.* By R. S. Hawkins. (*Bull.* 135, *Univ. of Arizona*, 1930.) Yields were increased from 15 to 25 per cent. on the lower ends of the borders which had been levelled as compared with the upper parts of the borders which had a fall of about 2 in. per 100 ft. Subsoiling before planting to cotton did not affect the yields. Differences in yields due to variations in the spacing of the plants in the row were both insignificant and inconsistent. Cotton given no cultivation other than scraping the surface of the soil with hoes for weed control yielded as well as that given ordinary cultivation. Cultivation is evidently of value largely in controlling weeds, in aiding water penetration (particularly on tight soils or land with considerable fall), and possibly in promoting soil aeration.

388. ARKANSAS. *Plant Pathology.* (*42nd Ann. Rpt. Arkansas Agr. Exp. Sta.*, 1930, *Bull.* 257. Abstr. from *Rev. App. Mycol.*, x., **3**, 1931, p. 162.) Further studies on wilt (*Fusarium vasinfectum*) resistance in cotton confirmed the superiority of the long staple Super Seven variety, while a degree of tolerance was also shown by D. and P.L., Arkansas 17, and Express 121. Among the medium staple varieties, which are in general the best suited to Arkansas conditions, Arkansas Rowdens 40 and 2088 and Miller are highly resistant to wilt, while Rowden 2119 and Cleveland 54 are tolerant. Of the shorter stapled varieties, Dixie Triumph and Dixie 14 are highly resistant to wilt, but late maturing, while Wilson Big Boll is tolerant but early, and therefore better adapted to a wider range of conditions. Preliminary experiments in Lee County indicate that potash-containing fertilizers may assist in the control of wilt, and also that dense sowing may help to improve the yield where the incidence of the disease is high. The incubation period of *F. vasinfectum* appears to be greatly prolonged by the low soil temperatures prevailing in April and early May.

389. TENNESSEE. *Cotton Cultivation*, 1929. By C. A. Mooers *et al.* (*Tenn. Sta. Rpt.*, 1929. Abstr. from *Exp. Sta. Rec.*, lxiv., 4, 1931, p. 335.) Varieties indicated for the northern limits of cotton production included Trice, Lightning Express No. 7, early strains of Acala, and D. and P.L. 4-8. Results at Jackson showed that longer lint varieties averaged higher in money value than the short varieties; such short growths as Half and Half were considered at a disadvantage in both domestic and foreign markets.

390. VARIETIES OF COTTON FOR NORTH TEXAS. By P. B. Dunkle. (*Bull. No.* 417, Texas Agr. Exp. Stat., 1930.) In tests of 179 varieties and strains of cotton at Substation No. 6, Denton, Texas, during the seventeen-year period 1913 to 1929 inclusive, Half and Half made the largest average yield, 283 lb. of lint per acre. It was followed by Sunshine, New Boykin, Harper, and Cliett Superior, with average yields of 248, 239, 238, and 236 lb. of lint per acre respectively. While Half and Half had the highest average yield and also the highest gin turnout, 41·5 per cent., it has certain objectionable features, such as small bolls and a short staple averaging only $\frac{3}{4}$ in., which makes it untenderable on future contracts. On the other hand, the better staple varieties—such as Sunshine, New Boykin, Harper, and Cliett Superior—are big-boll, storm-proof varieties with a gin turn-out ranging from 34 to 39·4 per cent., and produce staple of tenderable length, averaging $\frac{31}{32}$ to 1 in.

The selection of a variety of cotton for North Texas will depend largely on the system of marketing and prices paid. If cotton is bought on the "hog-round" or average basis, and no more is paid for staple cotton than for short and untenderable cotton, such as Half and Half, then this variety, on account of its higher yield, would be the most profitable variety to grow. If suitable differences in prices, however, can be obtained to compensate for the lower yield, then Sunshine, New Boykin, Harper, and Cliett Superior, which produce lint of tenderable length, $\frac{31}{32}$ to 1 in., would be more profitable to grow than Half and Half.

COTTON IN FOREIGN COUNTRIES.

391. ARGENTINA. *Cotton Cultivation.* (*Times Arg. Exhibn. No.*, March 10, 1931, p. 15. Abstr. from *Summ. of Curr. Lit.*, xi., **6**, 1931, p. 141.) Cotton promises to have an increasingly successful future in Argentina, the northerly provinces offering the warm climate and rich soil needed for its commercial cultivation. Small crops have been sown for many years, but modern scientific cultivation began only in 1923, when about 150,000 acres were devoted to cotton. In 1930 some 300,000 acres were cultivated, the greater part being in the Chaco territory, with the Napalpi department as the major producing area. During the season of 1922-23, Argentine growers harvested about 44,000 tons of raw cotton yielding some 13,000 tons of clean fibre, of which over 5,000 tons were exported. In 1929 out of a production of 29,000 tons of ginned cotton 25,000 tons were shipped abroad. Whilst at present the Chaco region is at the head of cotton-growing sections, great strides have been made in Santiago del Estero, in Tucuman, and in Formosa.

392. LE COTON DANS L'AFRIQUE CENTRALE. By A. De Bauw. (Soc. Belge d'Études et d'Expansion.) An interesting account of a visit paid to Central Africa and of the development of cotton cultivation in the Belgian Congo, which is expected to export about 10,000 metric tons (40,000 bales) in the current year.

393. BRAZIL. *The Textile Industry.* (*Text. Rec.*, xlviii., **576**, 1931, p. 76.) Within a period of five years the number of textile factories in Brazil has increased from 64 to 347, and the number of workers from 28,700 to 42,000. The spindles operating have increased from 600,000 to 2,800,000, and the number of looms from 20,500 to 78,000. Of the latter, however, only 934,000 spindles and 25,740 looms were in operation at the end of June, 1930, while the last six-monthly period of the year proved even more discouraging.

394. THE CHINESE COTTON-SPINNING INDUSTRY. (*Int. Cot. Bull.*, ix., **34**, 1931, p. 282.) There has been great expansion in the cotton-spinning industry in China during the past twenty or thirty years, but in regard to the production of raw cotton there has been a steady decrease in both acreage and output in the past few years owing chiefly to bad crops caused by unfavourable weather conditions.

395. COTTON CULTIVATION IN ERITREA (TESENEI). By A. Chiaromonte. (*Bot. Centr.*, **17**, 1930, p. 380. From *L'Agr. colon.*, **8**, 1930, p. 185. Abstr. from *Summ. of Curr. Lit.*, xi., **7**, 1931, p. 165.) The suitability of this region for cotton cultivation is discussed in relation to insect pests. The common bollworms, including pink bollworm, are rare or absent. Stem-borers and the cotton aphis are comparatively harmless. Stainer and the dusky bug and the leaf disease caused by *Empoasca facialis*, Jac. are absent. The district is separated from British Sudan by a belt of uncultivated land, a non-cotton zone. With careful selection of seed good results should be obtained.

396. Association Cotonnière Coloniale. We have received a copy of *Bull. No.* 2, 1931. The history of the Association is continued in this issue. Notes are included on cotton-growing in Algeria, Tunis, Morocco, Togoland, and Cameroons, and in addition there are the following interesting articles: "L'aménagement hydraulique et la mise en valeur de la Vallée moyenne du Niger"; "L'engraissement du bétail par les graines de coton, essais effectués au Maroc"; "Le coton dans l'Afrique Centrale," A. de Bauw.

397. Georgia. *Cotton Plant: Date of Sowing Experiments.* I. Gwingeriaja, (*Bot. Centr.*, **17**, 1930, p. 375, from *Bull. Inst. Exp. Agr., Georgia, Tiflis*, **3**, 1929, p. 85. Abstr. from *Summ. of Curr. Lit.*, xi., **7**, 1931, p. 165.) Sowings were made at different times from April to June of the varieties Kinch Karaiazi and No. 169, and the rate of growth of the plant and effects of increasing mean daily temperatures were studied. The temperature curves show that the temperature has a great influence on the flowering phase. With the later sowings this phase is accomplished in a very much shorter period than with the early sowings. On the other hand, the ripening proceeds more quickly in the earlier sown plants. The later sown plants are more strongly developed and have a considerably greater number of bolls, but the number of the opened bolls at the picking time is much smaller than the number for plants from the early sowings. It is concluded that early sowing is more advantageous for this region.

398. The Italian Cotton Industry. (*Text. Rec.*, xlviii., **577**, 1931, p. 40.) A statistical account of the manufacturing side of the industry.

399. Japanese Textile Machinery and Accessories: Trade in India. (*Ind. Text. J.*, **40**, 1930, p. 560. Abstr. from *J. of Text. Inst.*, xxii., **3**, 1931, A168.) Some historical notes are given of the different Japanese machinists trading in India. The Mitsui Bussan Kaisha, Ltd., of Bombay, are now the sole selling agents.

400. Peru. We have received a copy of *Mem.* 2*a* of the Estacion Experimental Agricola de la Sociedad Nacional Agraria, Lima, Peru, which contains, among others, articles dealing with cotton cultivation (O. B. G. Tafun), and cotton pests (J. Wille and J. B. Pope).

401. Russia. *Cotton Cultivation.* (*Int. Cot. Bull.*, ix., **35**, 1931, p. 333.) It is stated that nearly 6,000,000 acres will be planted to cotton in 1931, which is an increase of 50 per cent. in acreage over 1930, and the Government hopes by the use of fertilizers and better equipment to increase the crop 80 per cent.

Another report states that "the Russian cotton-producing programme dropped to a level in February which raised considerable doubt as to the possibility of realizing the entire amount called for in this year's plan."

402. Russian Textile Mills: Output and Organization. (*Text. Mfr.*, **56**, 1930. From "Seven-hour Day," *Int. Lab. Rev.*, League of Nations. Abstr. from *J. of Text. Inst.*, xxii., **4**, 1931, A214.) The seven-hour day and three-shift system were introduced at the close of 1927 in an attempt to increase the production of textile goods. Other measures were the abolition of the Sunday rest and the continuous five-day working week. The introduction of the seven-hour day was combined with a considerable increase in the intensity of work by an increase in the number of machine units tended by each worker. This speeding-up process began as early as 1925 in the cotton industry, before the introduction of the seven-hour day. The new arrangement led to a marked decrease in the hourly output of the machinery which the Soviet Press attributed to the engagement of new workers, the introduction of night work, and the increased number of looms or spindles per worker. The reduction in hourly output was, however,

more than compensated by the extension of the working hours of the machinery and by an increase in the amount of machinery in use. The daily volume of production in the third quarter of 1928-29 was increased by 39·1 per cent. and 30·3 per cent. respectively in spinning and weaving mills, as compared with the position before the introduction of the seven-hour day and three-shift system. In the factories that retained the eight-hour two-shift system there was during this period an increase of production of 9·9 in cotton-spinning and 15·2 in cotton weaving. The increase in production has, however, been accompanied by a noticeable decline in quality. The changes produced an increase in the hourly output of the workers; as compared with the position before the introduction of the seven-hour day the output in the second quarter of 1928-29 had risen by 13 per cent., and in the third quarter by 19 or 20 per cent. In the same period, however, the output in undertakings that had retained the eight-hour day has also risen considerably. The resulting lower daily output per worker in the seven-hour factories, as compared with that in the eight-hour factories, had an unfavourable effect on wages costs and on costs of production as a whole, and some disillusionment was felt about the seven-hour day and three shifts. In addition, the new system of hours of work has had a disastrous effect on the general working conditions and also on the general living conditions of the workers. In 1929 it was suggested that it would be advantageous for textile factories working three seven-hour shifts to change over to two eight-hour shifts with two days' rest a week.

403. Spain. *Cotton Cultivation.* (*Cotton*, M/c., April 11, 1931.) "Europe's Tennessee" is the name which has been given to an area in Andalusia, Southern Spain, where the orange groves have given place to cotton plantations. Spain imports every year about 448,000 bales of cotton, and this cotton-growing experiment was begun by General Primo de Rivera with the idea of reducing this import of raw material. There are now 50,000 acres devoted to cotton-growing, and production last year reached nearly 6,000 bales. The area under cultivation is to be increased by 30,000 acres each year. Spain has been importing considerable textile machinery from England in recent years.

404. The Swiss Cotton Industry. (*Int. Cot. Bull.*, ix., **35**, 1931, p. 419.) A report of "a lecture given by Mr. Caspar Jenny before the Economic Society of Zurich, which has recently been printed in pamphlet form. Mr. Jenny makes very instructive comparisons of wages in various countries, deals with present costs of mill construction, the introduction of the automatic loom, the necessity for double shifts for newly equipped mills, etc. In short, the lecturer not only reviews conditions in his own country, but also compares them with those of the other countries engaged in the cotton industry, and as he is a practical cotton-mill man who has also studied the economic aspects, we strongly advise those who have a knowledge of the German language to read this pamphlet of 21 pages." (Arno S. Pearse.)

SOILS AND MANURES.

405. Imperial Bureau of Soil Science. We have received a copy of the Proceedings of a Conference on Soil Science Problems held at Rothamsted Experimental Station in September, 1930. The Conference was arranged to facilitate meetings of British and Imperial workers interested in similar soil problems in different parts of the Empire. Twenty-eight representatives from overseas and forty-three in this country attended, in addition to members of the staff at Rothamsted. The following papers were read: "Mechanical Analysis," by Professor G. W. Robinson (Bangor); "Available Potash and Phosphorus," by

A. W. R. Joachim (Ceylon); "Soil Reaction and Lime Requirement," by P. J. Turner (Trinidad); "A Survey of the Soil Resources of the Empire," by Sir E. J. Russell; "Position of Soil Surveys in Various Parts of the Empire Overseas," by Dr. F. J. Martin (Sierra Leone); "Classification, Mapping, and Profile Examination," by Dr. W. G. Ogg (Edinburgh).

406. THE PHYSICAL PROPERTIES OF THE SOIL. By B. A. Keen. (Rothamsted Monographs on Agr. Science. Pubd. Longmans, Green and Co., Ltd., London. Price 21s.) This book has been written for two purposes: to supply an account of the subject for the use of agricultural research workers, teachers, and students, and to draw the attention of physicists to the wide range of research problems offered by soil and other porous materials displaying colloidal properties. The chapters are headed as follows: Historical Introduction, Mechanical Analysis, Distribution and Movement of Water in the Soil, Soil Properties at Low Moisture Contents, the Field Range, Soil and Clay Pastes and their Behaviour, the Properties of Soil and Clay Suspensions, Soil Constants and Equilibrium Points, Physical Properties of Soil under Field Conditions, Cultivation and Cultivation Implements, Soil Temperature, the Soil Atmosphere.

407. PHYSIOLOGICAL ASPECTS OF PLANT NUTRITION. By E. M. Crowther. (*Ann. Rpt. on the Progress of App. Chem.*, p. 532, 1929. Abstr. from *Trop. Agriculture*, vii., **11**, 1930, p. 303.) Stresses the importance of studies of the effects of soil nutrients—both those normally present and those added in manures—on the fundamental processes that go on within the plant-body, and which affect ultimate yield and quality.

408. SOILS AND FERTILIZERS. By Sir John Russell. (*Agr. Res. in* 1929, p. 120.) An interesting article dealing with many subjects of importance, including soil surveys and classification, British Empire developments, soil erosion, artificial fertilizers, effects of fertilizers on the composition and quality of the crop, etc.

409. UGANDA. *Soil Erosion.* (*Ann. Rpt. of Dpt. of Agr.*, 1929.) Field observations, and the results of mechanical analysis, have shown clearly that conditions on the slightest slope in most districts of the Protectorate are almost ideal for erosion. The fact that the subsoil is very compact means that all the rain in a heavy storm remains in the top few inches of soil, and once this is saturated, run-off starts and carries on down the slope with increasing velocity. This will not be serious in small native plots of an acre or less with uncleared land around, but it must be considered as a great potential soil deteriorant on larger clearings such as European-owned estates and the 100-acre clearings in the Eastern Province. Terracing is stated to be the surest check, and in spite of high initial cost is less expensive than the construction and upkeep of contour drains or silt pits. As terracing is not applicable to native agriculture, an experiment has been planned to test the effectiveness of contour hedge crops and surface drains in checking erosion; this experiment is to be put down at Serere and if possible at Bukalasa.

410. ENVIRONMENT AND PLANT DEVELOPMENT. By H. Lundegardh. (Translated from the German by Eric Ashby.) (Pubd. Edwin Arnold and Co., London, W. 1. Price 24s. net.) Deals with the subject as follows: The Light, Temperature, and Water Factors; the Ecological Properties, the Physical Structure and Aeration, and the Chemical Properties of the Soil; Soil Micro-Organisms; The Carbon Dioxide Factor; Principles of Experimental Ecology.

411. NITROGEN FIXATION IN FIELD SOIL UNDER DIFFERENT CONDITIONS OF CROPPING AND SOIL TREATMENT. By L. A. Bradley and J. E. Fuller. (*Soil Sci.*, xxx., **1**, 1930, p. 49. Abstr. from *Exp. Sta. Rec.*, lxiv., **1**, 1931, p. 18.) The

Massachusetts Experiment Station here reports a microbiological investigation constituting a phase of its researches on the relation of the treatment of the soil to power of crop production. The work noted consisted in part in the quantitative study of the plat soils under investigation; the determination of the nitrogen fixing ability of the organisms isolated; a morphological examination (which yielded the information that "the morphology of the organism, 9A, is typical for Azotobacter," that "in Ashby's solution or on Ashby's agar cultures up to one week old show a predominance of diplococcus forms somewhat granular when stained with erythrosin or rose bengal," and that "the cells are slightly smaller than those of three stock strains of *Azotobacter chromococcum* carried in the laboratory"); a study of the nitrogen-fixing ability of the soils of the plats; and a determination of the soil pH in the plats used.

"Results suggest that there is sufficient nitrogen fixation in the soil . . . to account for the nitrogen reserve. The nitrogen fixation observed in the plats is correlated with the presence of an Azotobacter strain designated as 9A. Nitrogen fixation and the distribution of organism 9A appear to have remained reasonably constant over a three-year period. The growth of different crops, including legumes and non-legumes, has not influenced nitrogen fixation or the presence of organism 9A in the field. . . . The soil reaction in the plats . . . does not appear to be a controlling factor in the nitrogen-fixing activity and the distribution of organism 9A; this organism tolerates a lower pH than that commonly accepted as a limiting factor for Azotobacter growth."

412. RELATIONSHIP BETWEEN POTASH AND THE CONSTITUENTS OF ARABLE SOIL. By M. Gallois. (*Int. Rev. of Agr.*, xxii., 3, 1931, p. 92.) The question of whether the so-called "available" potash (soluble in dilute acids) of soils is proportionate to soil elements such as clay, organic matter, lime, sand, etc., has been studied in a series of soils found near Oran, by the author, who is Director of the Chemical Laboratory of Sidi-Bel-Abbes, Algeria. His results are as follows:

(1) *Correlation between Available Potash and Potash Soluble in Concentrated Acids.*—None. The main factors in the solubility of potash are the form and particularly the combination in which it is present.

(2) *Available Potash and Clay Content.*—It might be expected that soils rich in clay would be the richest in available K_2O, but this does not appear to follow. The clay may be present in different physical forms which are not equally open to attack by weak acids.

(3) *Available Potash and Organic Matter.*—No apparent relationship.

(4) *Available Potash and Lime Content.*—A high lime content appears to be correlated with a low content in available potash and *vice versa.*

(5) *Available Potash and all Fine Non-Calcareous Elements.*—No relationship.

It would thus appear rash to assume any correlation between the availability of potash and the constituents of the soils studied.

413. AN IMPROVED METHOD FOR THE DETERMINATION OF AVAILABLE PHOSPHORIC ACID OF SOILS. By S. Das. (*Soil Sci.*, Baltimore, xxx., 1, 1930. Abstr. from *Int. Rev. of Agr.*, xxi., 10, 1930, p. 362.) The author collected a large number of soils typical of different regions of India, of which the fertility and reaction to manure are known (acid, humus, alkaline, calcareous, non-calcareous and lateritic soils). He determined the available P_2O_5, comparing his new method of extraction by a 1 per cent. solution of potassium carbonate with Dyer's method (extraction by a 1 per cent. solution of citric acid). Results: (1) K_2CO_5 extraction succeeded with all the soil types, while the citric acid extraction did not give good results with alkaline and calcareous soils. (2) In addition to more general applicability the K_2CO_5 extraction has other advantages, and may thus be used to replace

the method of Dyer and other similar methods based on the action of dilute acids.

414. Ammonium Phosphates as Fertilizers for Tropical Soils with Special Reference to India and Ceylon. By J. E. Walker. (*Agr. and Livestock in India*, i., **2**, 1931, p. 159.) Ammonium phosphates, varying in composition according to their chemical make-up and mode of manufacture, are being marketed on an increasing scale. Experiments carried out in America and other countries, and confirmed by work in India, show that the ammonium phosphate type of fertilizer can be substituted for the "elementary" or single plant-food fertilizers, with no detriment to yield. There is some possibility that phosphoric acid which is combined with ammonia, may be more effective than that combined with calcium by reason of greater penetrative power. The proportions of nitrogen and phosphoric acid supplied by compound fertilizers at present marketed comply well with current manurial practice in the tropics.

415. Recent Developments in Phosphatic Fertilizer Investigations. By T. S. Buie. (*Amer. Fertilizer*, Philadelphia, lxxiii., **9**, 1930, p. 24. Abstr. from *Int. Rev. of Agr.*, xxi., **12**, 1930, p. 444.) The author describes recent research work relating to the manufacture and use of phosphatic fertilizers. He makes a detailed study of the question of the treatment of superphosphates by ammonia, discusses the question whether their assimilability is reduced by the addition of lime and by the fixative influence of basic soil compounds, and concludes by giving a brief description of certain laboratory methods used for determining soil requirements for P_2O_5 (Neubauer, Deniges and Atkins, Winogradsky, etc.).

416. Progress in the Application of Fertilizers. By H. R. Smalley. (*Amer. Fertilizer*, Philadelphia, lxxiii., No. **9**, 1930. Abstr. from *Int. Rev. of Agr.*, xxi., **12**, 1930, p. 443.) In reference to cotton, the author states that during the last ten years, and particularly during the last three, remarkable progress has been made in the methods of applying fertilizers to cotton and maize, and especially in the application of chemical fertilizers in strips running beside the seed-lines, but not in direct contact.

417. Use of Commercial Fertilizers in the Growing of Cotton. By J. J. Skinner. (*N. Carolina Sta. Agron. Inform. Circ.* 53, 1930. Abstr. from *Exp. Sta. Rec.*, lxiv., **1**, 1931, p. 29.) A practical discussion of the functions and sources and responses to and methods of using the essential fertilizer ingredients on cotton.

418. America. *Cotton-Seed Meal as Fertilizer.* (*West India Comm. Circ.*, xlvi., **849**, 1931, p. 149.) About 215,000 short tons of cotton-seed meal were used in the United States as fertilizer during the year ended July 31, 1930, according to an official report quoted by the *Fertilizer, Feeding Stuffs, and Farm Supplies Journal*. This amount is nearly 9 per cent. of the total meal produced from the 1929 crop of seed, and shows an increase of 1 per cent. over the amount used for fertilizing purposes during the previous year. Approximately 139,300 tons were used directly by farmers, and about 76,000 tons by manufacturers in the production of commercial fertilizers.

419. Fertilizers from Locusts. (*Amer. Fertilizer*, Philadelphia, lxxiii., **5**, 1930. Abstr. from *Int. of Rev. Agr.*, xxi., **10**, 1930, p. 407.) In Argentina it is considered that locust control could be more effectively carried out if there were more demand for the fertilizer which is prepared from locusts in the following way. The locusts are left in a heap for some days to lose excess moisture, and then are sent to the factory where they are heated till they are reduced to a powder. This powder, which has an average content of 12 per cent. ammonia, 4 per cent.

tricalcic phosphate, and 2 per cent. potash, forms a valuable fertilizer. It has been manufactured for some years, and has considerably enriched the soils of the provinces of Mendoza and San Luis and the Chili border region. Exportation of locust fertilizer was commenced in 1930.

CULTIVATION, IRRIGATION, GINNING, USE OF SEED, ETC.

420. THE GERMINATION OF SEEDS, GROWTH OF PLANTS, AND DEVELOPMENT OF CHLOROPHYLL AS INFLUENCED BY SELECTIVE SOLAR IRRADIATION. By C. Sheard *et al.* (*Science*, lxxi., **1837**, 1930, p. 291. Abstr. from *Exp. Sta. Rec.*, lxiv., **1**, 1931, p. 22.) As the result of studies on the correspondence between the wave-lengths in solar radiation and effects on life processes and products, it is stated that the ultra-violet and infra-red portions of the solar spectrum stimulate germination and enhance growth and development, while the green, the region of maximal energy, inhibits germination and growth. Chlorophyll development is enhanced under the yellowish-green, green, and greenish-blue portions, while the least development of chlorophyll occurs under the ultra-violet and infra-red portions of the spectrum.

421. QUARTERING COTTON-SEED SAMPLES. By G. S. Meloy. (*Cotton Oil Press*, xiv., No. 5, 1930. Abstr. from *Exp. Sta. Rec.*, lxiv., **1**, 1931, p. 29.) A device for reducing or quartering a sample of cotton-seed and maintaining its characteristics, developed in the U.S. Department of Agriculture by the author working with F. S. Hubbard, is described and illustrated.

422. THE LATIN SQUARE ARRANGEMENT OF EXPERIMENTAL PLATS. By F. Z. Hartzell. (*J. Econ. Ent.*, xxiii., **4**, 1930, p. 747. Abstr. from *Exp. Sta. Rec.*, lxiv., **1**, 1931, p. 52.) In this contribution from the New York State Experiment Station it is pointed out that " variation in infestation vitiates conclusions drawn from field tests unless the plat technique is able to compensate for such heterogeneity. The Latin square arrangement of test plats proposed by Fisher has a number of advantages over the ordinary method of using strips across the area. The Latin square is applicable to areas in which the variation from plat to plat occurs by approximately constant differences. It does not always compensate for heterogeneity when differences occur by chance or in approximately geometrical series. Careful studies of proposed test areas should be made to determine the type of variation present, and no tests made except in those places in which a high degree of accuracy can be secured."

423. THE HILL PLANTING OF COTTON AND CHECKER CULTIVATION WITH LARGE TILLAGE IMPLEMENTS. By J. O. Ware. (*Agr. Engin.*, xi., **5**, 1930, p. 177. Abstr. from *Exp. Sta. Rec.*, lxiii., **9**, 1930, p. 880.) The results of field experiments at the Arkansas Experiment Station are reported. These showed that on bottom land or on other lands of a high degree of fertility cotton seems to produce as well when the plants are grouped in hills arranged for cross cultivation as when the plants are distributed in rows. Thickness of planting in hills appears to accomplish the same result in stimulating earliness as has been shown for close spacing in the drill. No exact number of plants to the hills seems necessary, and the number can range from 2 to 6 plants per hill, or around 10,000 to 25,000 an acre. However, since the production was lowered less with 15 plants to the hill than with 1 plant to the hill, the stand maintained should be nearer the upper limits of the range of highest yields rather than toward the lower side of this range.

Hill planting, cross harrowing, and checkered tillage practically eliminates the hoe as a weapon for killing grass and weeds, and renders hand thinning unnecessary except in an occasional hill where the plants are too numerous. The system of hill planting lends itself to easier adaptation of implements with larger

tillage capacity, and a larger cultivated area per farmer will necessitate the utilization of more power units per man.

A 2- or 4-row hill dropping planter should be used, depending on whether a 2- or 4-row cultivator is to be employed. If motorized cultivation is to be practised the 4-row machine is likely to be more economical. A cross-harrowing just previous to the sprouting of the cotton seed, and a second cross-harrowing at another angle immediately after the plantlets have straightened up from germination, should prevent any noxious plants from developing in the hills among the cotton plants. As a further precaution against the occurrence of foul plants, an early cultivation with a double-gang, spring-tooth cultivator is essential. The inside tooth of each gang should have a twist, so as to scoot fine dirt underneath the tender blades, thereby burying any tiny weed and grass seedlings that may be appearing around the young stalks. Rather large implements can be used to keep weeds and grass under control and to finish the seasonal cultivation.

[*Cf.* Abstrs. **379, 383-7, 397.**]

424. Hanauer-Gamble-Berry Cotton Harvester. Cotton Harvester Corporation of America. (*Text. World.*, **79**, 1930, p. 447. Abstr. from *Summ. of Curr. Lit.*, xi., **8**, 1931, p. 196.) The machine is geared to pick about 8 acres of cotton in ten hours, and is said to have picked as much as 90 per cent. of the opened cotton in going over a row the first time. The picking mechanism consists of two vertical drums, which revolve inwardly as the machine moves forward. Each drum contains a large number of picking members or needles. The needles are designed to penetrate all parts of the plant thoroughly, without compressing it into a narrow space, and without injury to the remaining bolls, squares, blooms, or foliage, or without damage to the plants. The drums may be raised or lowered, or moved toward or away from each other. The cotton is removed automatically from the needles and is conveyed by air to the sacks. The entire machine is operated with one control lever, and has standard gear shift, brake, and clutch pedal. Two men operate the machine, one to drive, and one to replace the rapidly filled sacks of cotton.

425. Revolutionary Cotton Harvesting. (*Int. Cot. Bull.*, ix., **34**, 1931, p. 221.) Experiments are now proceeding at the University of North Carolina with a new method of harvesting the cotton crop, but the cotton so gathered is intended for the manufacture of rayon. The main difference of the harvesting process is that the whole of the cotton plant, fibre, seed, stalk, etc., is cut down by a mowing machine and baled together. The purpose of the investigators has been to ascertain the practicability of utilizing the cotton plant for pulping, to determine at which stage in the life of the plant it contains the maximum of cellulose, and to determine what method of cultivation yields the highest percentage of cellulose per acre.

Professor Cameron, in charge of the experiments, outlines the results achieved as follows: "A large amount of interesting and potentially important scientific data has been accumulated. The results are very encouraging as showing that a preferred harvesting season can be determined at which the maximum cellulose production per acre exists, that all the plant can be utilized, the plant as a whole can be harvested, or the stems separately, and the harvest baled and shipped with or without previous ginning. Actual cost figures for growing and harvesting the crop have been obtained. The cellulose content of measured yield justifies the expectation that cotton can be grown profitably as a source of cellulose for the rayon industry in competition with wood pulp, and even possibly for higher grades of paper."

426. Cotton-Drying Plant. (*Int. Cot. Bull.*, **9**, 1930, p. 42.) A new machine has recently been used in the U.S.A. to dry damp seed cotton prior to ginning.

The machine is rather cumbersome in that it is about 60 ft. long. The cotton is fed into a slowly moving endless belt about 5 ft. wide, revolving above about 5 furlongs of steam piping of $1\frac{1}{2}$ in. diameter. The hot air is kept in motion above the belt and is discharged with the cotton, which is subjected to a temperature of over 200° F. Although the cotton was quite damp before entering the drier, it was perfectly ginned, with no neps. The time required to dry 1,500 lb. of seed cotton is thirty-five minutes, and an average of 15 lb. of moisture is taken out of a bale of cotton, but this weight of very wet cotton lost 160 lb. of moisture. According to the Division of Agricultural Engineering, the sale price of the average cotton dried improved by 2 cents a pound, due to better ginning.

427. Methods of Ginning in Relation to the Grade and Staple of Cotton. By D. T. Killough and G. T. McNess. (*Bull. No.* 416, Texas Agr. Exp. Sta., 1930.) The results are reported of experiments conducted on an air-blast type of gin at the Texas Agricultural Experiment Station, Main Station Farm, College Station, Texas, from 1926 to 1929 inclusive, to determine the effect which different speeds of saws, densities of breast-roll, and the use of the standard air-line cleaner have on the grade and staple of cotton of varying lengths. The results of these experiments show, in general, that a saw speed of 760 revolutions per minute, used together with the loose breast-roll and the standard air-line cleaner, provide the most favourable conditions for ginning cotton on the air-blast type of gin used. The use of the standard air-line cleaner resulted in improving the value of the cotton as much as two grades in some instances, by the removal of trash, dirt, and other foreign material. The cleaner did not appear to have any significant effect on the length of lint. Cotton ginned with a loose breast-roll classed higher at all three saw speeds, 640, 760, and 840 r.p.m., than that ginned with a tight breast-roll. Increasing the density of the breast-roll to a high degree had a tendency to damage both the lint cotton and the seed, and also to increase the time required for ginning.

428. Bad Ginning of Cotton in U.S.A. (*Int. Cot. Bull.*, 9, 1930, p. 41.) A sum of $100,000 has been voted by the United States Department of Agriculture to carry out experiments into the causes of bad ginning, and an experimental gin has been set up at Stoneville, Mississippi. It is stated that bad ginning causes an annual loss of $20,000,000 to the farmers in U.S.A. Experiments already undertaken by gin-makers indicate that the main causes of gin-cut and neppy cotton are the ginning of damp seed-cotton, and ginning it with a tight breast-roll, especially at high speeds.

429. On the Effect of Ginning on the Staple-Length of Cotton Fibres, and also on the Reliability of Random Sampling. By K. R. Sen. (*Agr. and Livestock in India*, i., 2, 1931, p. 142.) This work was undertaken with a view to learning whether the staple-length of cotton is greatly affected by ginning the kapas (seed-cotton) rather than separating the lint by hand, and also whether a random sample of kapas taken from the bulk of the produce and ginned yields a representative value for the average length of the fibres.

The cotton selected for examination was a pure strain (440) of Cambodia, and the kapas was secured from the produce of a self-fertilized, early sown, and duly irrigated plot.

The following conclusions are presented:

(1) Random selection of a sample from a bulk of cotton, provided the bulk has been ginned and thereby intermixed, is sufficient to represent the bulk so far as the average length is concerned.

(2) Ginning produces some breakage among fibres of about 1 in. and above in length, thereby decreasing the percentage of fibres above an inch in length, and at the same time increasing those of shorter length.

(3) There is a possibility of a considerable number of fibres over 1 in. in length breaking during hand-separating.

(4) The effect of ginning on the average length for an individual sample is not very remarkable, being so slight as to be within the limits of experimental error.

430. COTTON GIN RUBBER-SPIKED DISTRIBUTOR BELTS. Diamond Rubber Co. (*Text. World*, **78**, 1930, p. 2718. Abstr. from *Summ. of Curr. Lit.*, xi., **3**, 1931, p. 52.) It is claimed that all grades of cotton, including wet boll cotton in bad ginning condition, can be handled with the new rubber-spiked distributor belts. The rubber spikes do not break or become detached from the belt, and should an accident happen, the spikes cannot damage the gin saws or produce any spark to cause a fire loss. The flexible rubber spikes are made in units of five and six, which are mounted on hard rubber bars and bolted to the belt with special clamps. The belt is made with four plies of high-grade belt fabric and rubber. Heads of the bolts and flat washers are countersunk, so as to be flat with the belt surface and thus eliminate the necessity of special grooves in pulleys. Bolts are passed through the washer, belt, spike-bar, and a metal clamp, and the split ends of the bolts are spread with a chisel, which permanently attaches the unit.

PESTS, DISEASES, AND INJURIES, AND THEIR CONTROL.

431. INSECTS AND CLIMATE. By B. P. Uvarov. (*Trans. Ent. Soc. of London*, lxxix., **1**, April 24, 1931. Price 21s.) This volume of 247 pages is one of the most important general papers that have appeared for some time: its publication has been made possible by the aid of the Empire Marketing Board. It may be looked upon as an illustration of the recent movement towards the regarding of insect outbreaks as symptoms of deeper-lying causes. As is stated in the introduction, the chief aim of the economic entomologist must be to foresee and to prevent outbreaks, and for this all conditions that accompany or cause outbreaks must be thoroughly investigated, the injurious insect being recognized as an integral part, and even as a product, of its environment.

"The book is devoted to a very thorough review of the effects of climate upon insect life. Climate is the ever-present, and probably the chief, external factor in insect life. These considerations lead inevitably to the conclusion that any studies on a living insect must begin with the investigations of its climatic environment. This conclusion is, of course, far from being original, as is evidenced by the existence of an enormous literature on the influence of climatic factors on insects. This literature, however, is very scattered, and so far no attempt has been made to take stock of it, in order to see what is already known, and what remains to be studied. The present summary was started with this end in view, and is intended mainly as a basis for practical bioclimatic studies on economic insects. Climate, however, is an extremely intricate complex of phenomena, and it is hopeless to attempt to study its influence on insect life by methods other than analytical. Each separate factor of the climatic environment should be studied by itself, and its effects on each phase of the insect's life should be investigated independently.

"This work belongs to the field of experimental physiology, which studies the responses of an organism to the controlled degrees of each isolated factor. Accordingly, the first part of this summary deals with the data obtained by investigators of insect physiology, and is intended to serve as a theoretical foundation for the second part, which contains a survey of the facts relating to the influence on insects of the climatic environment as it exists in nature. Many entomologists would be inclined to suggest that the latter is the only kind of data that can be

of any practical value, while the investigations under experimental conditions have a very remote relation to the actual course of events under natural conditions. It will be seen from the summary that this view is erroneous, since most of the problems of distribution, development, and of the activities and abundance of insects can be attacked only on the basis of a thorough understanding of the physiological processes involved. The physiological research carried out in a laboratory is a basis for the practical studies in the field.

"From this point of view, physiological investigations on an insect should, in their turn, not be regarded as an end in themselves, but should be planned and carried out in such a way that the results can be utilized in field work. This means that the combinations of factors studied in experimental work should always be chosen with due regard to the conditions which an insect is likely to encounter in nature. It is only by judicious correlation of experimental work with actual conditions, and of the practical conditions with the results obtained in a laboratory, that most of the problems of insect epidemiology can be elucidated, if not solved."

No economic entomologist can afford to be without this book, which also contains an extensive bibliography of 46 pages and good indexes.

432. Biological Control. By A. D. Imms. (*Trop. Agriculture*, viii., 1931, **4**, p. 98, **5**, p. 124.) Pt. I. of this interesting article deals with the introduction of specific parasites or predators into countries where they did not previously exist, and also with the utilization of indigenous parasites. Pt. II. is concerned with the application of biological measures in the control of noxious weeds.

433. A Textbook of Agricultural Entomology. By K. M. Smith. (Cambridge Univ. Press, 1931. Price 12s. 6d. net.) This is one of the best textbooks on the subject we have seen, and though it only deals with the farming practice of the colder zones, is well and systematically arranged, forming a good introduction to methods that may be employed in the tropics or elsewhere. After a brief introduction on the organization of agricultural entomology, the general methods of control (including biological and legislative) are described in their relation to farming practice, followed by a chapter on the effect of weather conditions upon outbreaks. The bulk of the book is occupied by detailed descriptions of harmful insects, taken family by family. The general characters, the life history, and the methods of control of each are given, and wild host plants upon which the insects may survive in the off-season are mentioned, as well as all natural enemies (usually parasitic larvæ) found. Finally, there are chapters on virus diseases and their relation to insects, on the characteristic symptoms of insect attack, and on weeds in their relation to pests. The book is well illustrated, has good indexes, and may be cordially recommended.

434. A New Design for an Entomological Light Trap. By C. F. Wu. (*Bull. Dept. Biol. Yenching Univ.*, i., No. 4, p. 51, Peping, China, 1930. Abstr. from *Rev. App. Ent.*, xix., Ser. A, **3**, 1931, p. 143.) The trap is composed of two sections. The lower one consists of a wooden case, 27¼ by 24 by 24 in. with short legs and a door on one side, and contains a large tin funnel leading from an opening in the top, 10½ in. in diameter, into a killing bottle or a glass jar half filled with 80 per cent. alcohol, and provided with a cardboard lid, through which the end of the funnel passes. The top and base of the upper section, which are of wood, are joined together at the corners by four uprights, 11 in. high. The sides consist of pieces of glass sloping inwards from the top and held at the edges by four wooden supports, the upper ends of which are joined to the uprights and the lower ones to the base of the section. The closed chamber thus formed, which

has a base 6 in. square, is provided with a small removable lid that carries a socket from which a 100-watt electric bulb is suspended, to attract the insects to the trap. There are four other removable pieces of glass, one at each side of the section, that arise from the base and slope upwards and inwards; these are held at the edges by four wooden supports, the lower ends of which are attached to the base of the uprights and the upper ones to the four other sloping supports, which they meet at approximately a right angle. Between the fixed and the removable pieces of glass a slot of about an inch in width is left. The insects enter the trap through it and fall through slots made at the base of the section into the funnel below. Within the lower section, a 50-watt bulb is fixed to one of the sides, opposite the upper half of the jar, to attract the insects crawling in the funnel into it.

435. Mass Production of Egg Parasites of the Genus *Trichogramma*. By S. E. Flanders. (*Hilgardia*, iv., **16**, 1930, Univ. of California.) Deals with the possibilities of the practical use of *Trichogramma* in biological control work, since the production of this parasite in large quantities is now feasible. Its use against the corn-ear worm and other insects is being investigated.

436. The Appearance in Masses of Injurious Insects. By N. A. Grossheim. (In Russian, with a summary in English.) (*Bull. Mleev Hort. Expt. Sta.*, **26**, 1930. Abstr. from *Rev. App. Ent.*, xix., Ser. A, **3**, 1931, p. 132.) The author discusses the main characteristic features of outbreaks of insect pests—namely, their periodicity and sudden appearance and disappearance—and concludes that the presence or absence of food, meteorological conditions, activity of man, and biological factors do not play a decisive and constant part in the fluctuations of the numbers of insects. The relation between a host and its primary and secondary parasites is discussed at some length and explained by means of graphs and mathematical formulæ. The author does not consider that the curve of abundance of parasites rises above that of the host at the end of an outbreak, and outlines a theory according to which the curves representing fluctuations in the abundance of parasites are always below that of the host, though approaching it most nearly when it falls. The author considers that outbreaks depend on changes in the reproductive capacity of the female insects, which fluctuates from unknown causes with different generations within one or several consecutive years. The rate of egg production of the host is, however, always higher than that of the parasite.

437. The Organization of Quarantine to Prevent the Introduction from Abroad of Pests of Cotton into U.S.S.R. By A. M. Panteleev. (In Russian.) (*Khlop. Delo.*, viii., **12**, 1929, pp. 1437-1455. Abstr. from *Rev. App. Ent.*, xix., Ser. A, Pt. II., 1931, p. 78.) The economic importance of *Platyedra* (*Pectinophora*) *gossypiella*, Saund., *Earias insulana*, Boisd., and the Mexican cotton boll weevil *Anthonomus grandis*, Boh., is briefly discussed, and notes are given on the history of the organization of the quarantine service in Russia, which was inaugurated in 1914, against the first two pests.

438. Entomology in the Tropics. By C. B. Williams. (*Trop. Agriculture*, viii., **5**, 1931, p. 119.) An account of the writer's own work in Egypt, East Africa, West Indies, and South America. An interesting observation in connection with locusts was made at Amani (Tanganyika) in February, 1929, when a large flight of locusts appeared accompanied by swarms of a large burrowing wasp (probably *Sphex ægyptiacus*) which were preying on them. Within an hour of their arrival these wasps were burrowing into the ground for dear life, and as soon as the holes were finished they stocked them with paralyzed locusts. About lunch

time on the second day the locusts began to depart, and by 2.30 neither Sphex nor living locust could be seen. There is no doubt that the wasp had developed a migratory habit, and was thus enabled to keep in touch with the migrating hordes of its host.

439. Les Insectes Nuisibles au Cotonnier dans les Colonies Françaises. By P. Vayssière. (*Faune Colon. françaises*, iv., **3**, p. 193. Paris: Soc. d'Editions geogr. marit. colon., 1930. Price fr. 60. Abstr. from *Rev. App. Ent.*, xix., Ser. A., **3**, 1931, p. 133.) In addition to information contained in a previous work, which is here revised and amplified, this monograph includes data gathered from reports from the various French colonies where cotton is cultivated, and forms a complete guide to the insects attacking cotton in these territories, together with the control measures employed against them. As a result of collating in a single work information on pests occurring in countries often widely separated, it has been possible to arrive at some conclusions regarding the problems of the biological or geographical races of certain insects.

[*Cf.* Abstr. **572**, Vol. IV., of this Review.]

440. India. *Cotton Pests.* (*Sci. Rpts. of the Agr. Res. Inst., Pusa,* 1929-30, p. 73.) From the report of the Imperial Entomologist we learn that further observations on the parasitization of *Bemisia gossypiperda*, Misra and Lamba, were made throughout the year. It was found that the parasitization locally was very low. *Empoasca* sp. appeared on broad-leaved varieties of cotton at the beginning of the season. Parasites on *Pseudococcus corymbatus*, Green, were reared for despatch to Egypt, but as suitable arrangements could not be made in time this work was kept in abeyance. *Platyedra gossypiella*, Saund., was again bred from seeds of *Hibiscus abelmoschus*.

441. Coup D'Œil sur les Principaux Ennemis du Cotonnier au Mozambique. By P. Lesne. (*Rev. Bot. Appl.*, x., **110**, p. 781. Paris, 1930. Abstr. from *Rev. App. Ent.*, xix., Ser. A, **3**, 1931, p. 133.) An account is given of the principal pests of cotton in the Zambesi region, which include *Oxycarenus* spp., particularly *O. hyalinipennis*, Costa, *Dysdercus fasciatus*, Sign., *D. superstitiosus*, F., *Empoasca* (*Chlorita*) sp., *Earias insulana*, Boisd., *Diparopsis castanea*, Hmps., and *Apiona* sp., a weevil that lives in the stems. *D. castanea* and *Dysdercus* spp. are considered to be the most injurious. Minor pests include *Heliothis obsoleta*, F. (*Chloridea armigera*, Hb.), *Tarache nitidula*, F., *Xanthodes graellsi*, Feisth., *Aphis gossypii*, Glov., *Zonocerus elegans*, Thnb., *Acrocercops bifasciata*, Wlsm., *Pyroderces simplex*, Wlsm., the Lamiid *Tragiscoschema tenuicorne*, Thoms., which mines in the stem, though the injury is not apparent until the cotton is well grown, and the Meloids, *Epicauta velata*, Gerst., and *Decapotoma catenata*, Gerst., and the Clytrid, *Antipa ruficollis*, Ol., which attacks the flowers.

442. Persia. *Cotton Pests.* By A. H. Adle. (*Int. Bull. Plant Prot.*, v., **1**, 1931, p. 8. Abstr. from *Rev. App. Ent.*, xix., Ser. A, **4**, 1931, p. 188.) Discusses the distribution of *Earias insulana*, Boisd., on cotton in Persia; in one case the loss to the crop was estimated at 52 per cent. Locusts caused less injury to the crop in 1930 than in 1929.

443. Russia. *Pests of Cotton in the New Cotton-Growing Regions.* By P. V. Popov. (In Russian.) (*Khlop. Delo.*, ix., **2-3**, 1930, pp. 349-353. Abstr. from *Rev. App. Ent.*, xix., Ser. A, Pt. 2, 1931, p. 78.) A list is given of insect pests that have been recorded in the literature since 1925 as injuring cotton in the Volga delta, North Caucasus, and Daghestan, with brief notes on their distribution and the amount of damage caused. The maize moth, *Pyrausta nubilalis*, Hb., is stated to have attacked cotton in small numbers in the Astrakhan district.

444. Pests of Cotton in Transcaucasia and how to Control them. By I. I. Evstropov. (In Russian.) (Tiflis, Izd. Zakavk. Khlopk. Komiteta, 1929. Abstr. from *Rev. App. Ent.*, xix., Ser. A, Pt. 2, 1931, p. 78.) In this popular handbook an account is given of the bionomics of the more common pests of cotton in Transcaucasia—viz., *Tetranychus telarius*, L., *Aphis gossypii*, Glov., *Heliothis obsoleta*, F., *Euxoa segetum*, Schiff., *Laphygma* (*Caradrina*) *exigua*, Hb., *Gryllotalpa gryllotalpa*, L., and Acridids. Notes on agricultural and chemical measures of controlling them are included, and a separate chapter deals with insecticides and spraying and dusting apparatus.

445. The Boll-Weevil Situation. (*Int. Cot. Bull.*, ix., **35**, 1931, p. 343.) Summarizing data presented in the report of the American Cotton Crop Service on March 18, "Weevil damage to the 1931 crop may be expected to be severe in any part of the infested area of the Cotton Belt where low temperatures, together with showery weather conditions, are experienced during the hatching period of the first weevil generation. Where dry, hot-weather conditions prevail damage will be moderate. The fact that no particular campaign is being waged to interest cotton-growers in poisoning the weevil during the coming season may prove disastrous. Dusting machinery, used for applying poison for controlling the weevil, has mostly 'rusted out' from lack of use and care."

446. Cotton Pests in Texas. (*Int. Cot. Bull.*, ix., **35**, 1931, p. 364.) According to Dr. F. L. Thomas, Chief Entomologist, average boll-weevil damage is anticipated this season, but the cotton flea-hopper as a pest of cotton is expected to become of major importance in Central and East Texas during 1931.

447. Biology of the Mexican Cotton Boll-Weevil. V. Diurnal Observations of the Emergence of Boll Weevils from their Hibernation Quarters. By E. F. Grossman. (*Flor. Ent.*, xiv., **3**, 1930, p. 45. Abstr. from *Rev. App. Ent.*, xix., Ser. A, **1**, 1931, p. 16.) Experiments in Florida showed that *Anthonomus grandis*, Boh., usually leaves its hibernating quarters during the daytime, though emergence at night was also observed. Owing to the fact that in every year individuals emerge daily from March 1 to mid-July, regardless of climatic conditions, it appears that the weevils emerge when they are physiologically ready to do so, and that daylight, rainfall, and rises of temperature have little effect in accelerating the process.

448. Pink Bollworm in Algeria. By — Delassus. (*Int. Rev. of Agr.*, xxii., **1**, 1931, M 4.) This pest occurs in all districts in Algeria, and arrangements have been made for the burning immediately after picking of all plants left in the fields, and the disinfection of seed. The latter will be carried out at Oran by means of hydrocyanic gas, and the tanks already installed allow of the treatment of 30 tons a day. Light traps (consisting of an acetylene lamp above a tank containing water and petrol) have been used as a means of control, but it is suggested that the trap used last year to control the cigarette beetle would be more efficacious; this consists of paper glued on both sides and fixed on a framework arranged round a light. Investigations carried out at Perregaux, however, indicated that acetylene had sufficient power of attraction, and it did not appear necessary to use blue screens, as recommended by certain writers. It was also considered that traps should not be lighted only in the evening, since the number of moths collected was often greater at dawn.

449. The Pink Cotton Bollworm in Turkey. By K. Demokidov. (In Russian.) (*Khlop. Delo.*, viii., **10**, Tashkent, 1929. Abstr. from *Rev. App. Ent.*, xix., Ser. A, Pt. 2, 1931, p. 77.) An account is given of investigations carried out in Turkey from October, 1928, to November, 1929, on infestation of

cotton by pink bollworm, and the possibility of its spread to the cotton plantations in Transcaucasia. To prevent this the establishment of quarantine stations in the town of Igdir and on the Transcaucasian side is recommended.

450. THE SUDAN BOLLWORM (*Diparopsis castanea*, HMPS.) IN THE SUDAN. By W. E. Giffard. (*Bull. Welcome Trop. Res. Lab. Sudan Govt. Ent. Sect. No.* 27, 1929 [?], Khartoum. Abstr. from *Rev. App. Ent.*, xix., Ser. A, Pt. 3., 1931, p. 165.) An account is given of the distribution and bionomics of *Diparopsis castanea*, Hmps., on cotton in the Sudan, and all its stages are described. Most of the observations discussed were made at Shendi in Berber Province. The eggs are deposited, usually singly, on practically any part of the cotton plant, moths in the insectary laying ten to twenty a night. From August to October the egg stage lasts four to eight days, and from November to March six to eleven. The young larvæ cause severe shedding by tunnelling through the flowers, buds, and young bolls, and the more mature ones attack the larger bolls, which they hollow out, a nearly mature boll providing sufficient food for the larva to complete its development. Fungous spores may enter and attack the boll through the hole left by the mature larva. The average length of the larval stage in captivity during the short cycle period (late July to October) is about seventeen days with a minimum of fourteen, and during the remainder of the season it lengthens to an average of rather over three weeks, and may be prolonged to four. The length of the pupal period is extremely varied. Most of the larvæ pupating early in the season become adult in thirteen to twenty-five days, though it appears probable that some may adopt a definite resting stage. From the end of October to March the period is gradually lengthened, and the proportion of larvæ adopting a prolonged pupal stage is increased. In the laboratory emergence of adults from resting pupæ occurred throughout the year, except from April 24 to July 16, the majority emerging during August and September.

The numbers of *D. castanea* present in the field rapidly increase from the beginning of August to mid-November, and continue increasing slightly till mid-January, when the bulk of the crop should be coming in. Then there is a rapid decrease, owing to the majority of larvæ that pupate at this time remaining as pupæ until the next season's crop is in flower. In the author's opinion there is a greater loss at Shendi when cotton is infested by *D. castanea* than by *Platyedra gossypiella*, Saund. (pink bollworm).

Attempts to destroy the pupæ in April to May by ploughing to a depth of 6 in. were unsuccessful. Pupæ exposed to the sun are killed, but some survived when covered by an inch of soil. Complete control could probably be effected over small areas by collecting the eggs and by trapping the moths at night, but over large areas the cost would be prohibitive.

451. THE LIFE HISTORY, BIONOMICS, AND CONTROL OF COTTON STAINERS (*Dysdercus* SPP.) IN SOUTH AFRICA. By G. C. Ullyett. (*Sci. Bull. No.* 94, Dpt. of Agr. S. Afr., 1930.) Three species of stainer occur in the Union, and the life history and bionomics of one of these (*Dysdercus nigrofasciatus*, Stal.) is dealt with in this paper. Natural enemies of *Dysdercus* are not sufficiently numerous to afford a check. *Rhinocorus segmentarius*, Germ., is a predator. There is no satisfactory method of control at present. Early planting where possible, and the use of cotton-seed traps in ratooned cotton, are measures suggested.

452. EL "ARREBIATADO" DEL ALGODON EN PIURA. By J. B. Pope. (*Bull. No.* 3, 1929. Estacion Experimental Agricola de la Sociedad Nacional Agraria, Lima, Peru.) Deals with the life history, geographical distribution, investigations on, and methods of control suggested for the cotton stainer (*Dysdercus ruficollis*, L.), which causes injury to cotton in Piura and other districts of Peru.

[*Cf.* Abstr. 616, Vol. VI., of this Review.]

453. Observations on the Influence of Temperature and Humidity on the Bionomics of *Dysdercus cingulatus*, Fabr. By D. H. Mehta. (*Bull. Ent. Res.*, xxi., **4**, 1930, p. 547. Abstr. from *Rev. App. Ent.*, xix., Ser. A, **3**, 1931, p. 174.) During 1927-29 investigations were carried out in the Punjab to determine the correlation between a poor cotton crop and a reduction in the numbers of *Dysdercus cingulatus*, F.

The following is largely taken from the author's conclusions: Laboratory experiments and observations in the field indicate that temperature and humidity are the two main factors that control the abundance of *D. cingulatus*. The younger nymphs and adults are almost absent in the field during the period May to August, a fact that is due to the influence of low humidity and high temperatures in preventing pairing and oviposition, and increasing the rate of mortality of eggs, nymphs, and adults. As the season advances and more favourable temperatures prevail, activity is resumed, the vital processes begin to function, and a gradual increase in the numbers of the insect occurs. During the winter metabolism is retarded, and there is thus a marked decrease in the numbers of the bug following a severe spell of cold weather. The failure of the cotton crop has been stated to be due to low humidity and high temperature, and if this is so, the plant and the pest are affected independently by the same adverse climatic conditions.

454. Preliminary Report on the Study of the Cotton Owlet Moth. By V. N. Rekach. (In Russian.) (*Khlop. Delo.*, ix., **9**, 1930, p. 1079. Abstr. from *Rev. App. Ent.*, xix., Ser. A, Pt. 3, 1931, p. 160.) Observations were carried out in two areas in Azerbaijan in 1929 on the status of *Heliothis* (*Chloridea*) *obsoleta*, F., as a cotton pest. Four generations occurred during the year in each area. In one of them *Cicer arietinum* is extensively cultivated, and the larvæ concentrated on it, infestation rising to 84 per cent., as compared with a maximum of 8·5 per cent. on cotton. In the other area cotton was attacked by the larvæ of the second generation about the end of June, infestation reaching 33 per cent. about mid-July; the third generation infested 27 per cent. of the plants, and the fourth 15 per cent. In Azerbaijan the larvæ of the second generation are usually the most numerous, and those of the fourth are always scarce.

Laboratory and field observations on the damage caused to cotton showed that in 32 per cent. of the cases observed the larvæ fed on buds, flowers, and ovaries without damaging the bolls; in the other cases the larvæ of the last two instars injured the bolls, each larva almost always damaging one boll only. Usually not more than two locules are attacked, and sometimes the remaining locules open and produce normal fibre. It was found that on an average a larva injured 12 to 14 per cent. of the buds, flowers, and fruit on a plant. The damage was chiefly caused on the upper and outer parts of the plant, where the buds and flowers are particularly liable to drop. As the ripe bolls occurred near the main stem, this injury had no effect on the productive capacity of the plants. Moreover, if the flowers or bolls near the stem were damaged, those on other parts of the plants were rendered more vigorous and able to develop, whereas under ordinary circumstances they would have fallen off. Experiments showed that dusts are effective if applied during the period of two to five days when the young larvæ are feeding on the leaves, and before they penetrate into the buds or flowers.

The author is inclined to think that the economic importance of *H. obsoleta* as a pest of cotton has been somewhat overrated. A high yield of cotton may be obtained even from severely infested fields, owing to the peculiar reaction of the plants to the injury caused.

455. A Preliminary Note on the White-fly of Cotton in the Punjab. By M. A. Husain. (*Agr. J. of India*, xxv., **6**, 1930, p. 508.) Deals with the

history of the White-fly in the Punjab, the investigations carried out, description and life history of the pest, alternative food plants, incidence of attack on the different varieties of cotton, nature of injury, white-fly and the cotton failures.

The author states that since investigations are still incomplete, it would be premature to express any definite opinion as to whether white-fly has been responsible for cotton crop failures in the Punjab. There is not the slightest doubt that it is a serious pest of cotton, but it is highly doubtful if it is the *main* cause of the widespread failure of the crop, particularly the American varieties.

456. PRELIMINARY NOTE ON LEAF-CRINKLE OF COTTON IN THE GEZIRA AREA, SUDAN. By T. W. Kirkpatrick. (*Bull. Entomol. Res.*, xxi., **2**, 1930. Abstr. from *Rev. App. Mycol.*, x., **3**, 1931, p. 187.) This is a full account of the experiments on which the author based his statement that leaf-curl or crinkle of cotton is mainly, if not exclusively, transmitted in the Sudan by white flies (Aleurodidæ). Hitherto all attempts to transmit crinkle (which is believed to reduce the number of bolls set by each plant, as well as the number of seeds per boll) by the following methods have failed: scratch inoculations on old and young leaves and stems with the expressed juice of diseased plants; rubbing the leaves of healthy plants with crinkly leaves; and insertion of fresh crinkly tissue into healthy stems. General evidence having been obtained that insects were responsible for the transmission of the disease, experiments were conducted under controlled conditions with *Empoasca fascialis*, the only member of the Jassidæ commonly occurring in the Sudan, and with an undetermined species of white-fly. The tests with the former insect gave negative results, while eight out of nine cotton plants grown under glass and muslin in water cultures on which white flies from crinkly cotton were placed developed the disease in thirteen to thirty-two days; in two cases the symptoms were quite as severe as those occurring in the field. The remaining plant showed no symptoms of crinkle in twenty-seven days, but developed them on the new growth ten days after the removal of the growing point. None of the eight controls, grown in cultures from which white flies were excluded, developed a trace of crinkle.

It is concluded from these studies that white flies are probably the sole vectors of crinkle. A number of transmission experiments with flea-beetle (*Nisotra uniforma*) gave negative results, and even if aphids act as subsidiary carriers, they cannot be responsible for the main spread of the disease, since they are practically non-existent on cotton in the Gezira until late in the season.

Observations (which are tabulated) on the spread of crinkle at the Gezira Research Farm indicate that a plant may develop the disease in a severe form within three weeks from the first detection of the symptoms. The time of sowing appears to exert some influence on the intensity of the crinkle symptoms, and also on the date of their appearance, the period elapsing between sowing and the development of 75 per cent. infection being 85, 151, and 136 days for seed sown on August 15, October 5, and October 22 respectively. It is hardly possible as yet, however, to draw any definite conclusion from these preliminary trials. The symptoms of leaf crinkle have also been observed on *Hibiscus esculentus* and *H. cannabinus*.

[*Cf.* Abstr. **104** in this volume.]

457. LEAF-CURL IN COTTON. By M. A. Husain. (*Nature*, cxxvi., **3190**, 1930, p. 958. Abstr. from *Rev. App. Mycol.*, x., **3**, 1931, p. 188.) Referring to Kirkpatrick's statement that leaf-curl or crinkle of cotton in the Sudan is transmitted mainly by an undetermined species of white fly (Aleurodidæ), the writer reports the constant occurrence of another member of this family, *Bemisia gossypiperda*, in immense numbers on cotton in the Punjab. This insect, however, causes no malformation of the infested leaves even under controlled conditions in cages,

whereas the jassid, *Empoasca devastans*, is considered to be definitely responsible for a form of leaf crinkle.

[*Cf.* Abstr. **104** and **456** in this volume.]

458. THE BROWN CUTWORM (*Euxoa radians*, GUEN.) By G. A. Currie. (*Queensland Agr. J.*, xxxv., **1**, 1931, p. 18). Section V. of this paper deals mainly with environmental factors, resistance of the pest to submergence, starvation, and cold, reported outbreaks, prediction of outbreaks, host plants, natural enemies.

[*Cf.* Abstrs. **99** and **278** in this volume.]

459. NEW BRACONIDÆ AND OTHER NOTES. By D. S. Wilkinson. (*Bull. Ent. Res.*, xxi., **3**, 1930, p. 275. Abstr. from *Rev. App. Ent.*, xix., Ser. A., Pt. 1, 1931, p. 26.) The Braconids dealt with include *Argyroploce earterus* n. sp. from *Earias insulana*, Boisd., and *Diparopsis castanea*, Hmps., in Anglo-Egyptian Sudan; *A. thurberiæ*, Mues., from *Platyedra gossypiella*, Saund., in Trinidad.

460. A NEW LEAF MINER OF COTTON IN PORTO RICO (*Nepticula gossypii*, n.sp.) By W. T. M. Forbes and M. D. Leonard. (*J. Dpt. Agr. Porto Rico*, xiv., **3**, 1930, p. 151. Abstr. from *Exp. Sta. Rec.*, lxiv., **3**, 1931, p. 247.) A lepidopterous leaf-miner found severely infesting the leaves of Sea Island cotton in a small field near Juana Diaz is described as new under the name of *N. gossypii*. Notes on its life history, habits, parasites, and economic importance are included.

461. THE LOCUST PROBLEM IN INDIA. (*Proc. of the Bd. of Agr. in India*, December, 1929, recently received.) At the fifteenth meeting of the Board of Agriculture in India the question of investigating the biology of the locust and suggestions for control measures were discussed. The following notes on the subject were presented: "The Locust Attack of 1926-27 in Sind, Kathiawar, and Gujarat," by H. W. Mann and W. Burns; "Locusts in India," by T. Bainbridge Fletcher; "Locust Problem in India," and "Locust Control Methods and Organization," by P. B. Richards; "The Desert Locust in the Punjab," by M. A. Husain.

462. LOCUST CONTROL IN UNITED PROVINCES, INDIA. (*Allahabad Govt. Press*, 1930. Abstr. from *Rev. App. Ent.*, xix., Ser. A., Pt. 2, 1931, p. 60.) The first part of this paper, "Brief Instructions issued by the Local Government," gives a summary of the main points of the life history and habits of *Schistocerca gregaria*, Forsk., and measures for its control in the United Provinces, which are dealt with in detail in the memorandum by P. B. Richards, which constitutes the second part of the paper. The third part, by D. B. Emerson, deals with the utilization of water supplies for control of the pest in irrigated areas.

463. THE DESERT LOCUST (*Schistocerca gregaria*, FORSK.). By H. H. King. (*Bull. Wellcome Trop. Res. Lab. Sudan Govt. Ent. Sect. No.* 30. Khartoum, 1930. Abstr. from *Rev. App. Ent.*, xix., Ser. A., Pt. 3, 1931, p. 167.) Particulars are given of the seasonal occurrence in the Sudan of *Schistocerca gregaria*, Forsk., and the bionomics and appearance of the hoppers of ph. *solitaria*, which may be met with at all seasons throughout the central and northern provinces of the Sudan, are compared with those of ph. *gregaria*. There is reason to believe that all migrating swarms of *S. gregaria* follow definite routes, the progeny returning to the district whence their parents came. Thus most of the swarms that come to the Sudan for summer breeding seem to arrive from the east, apparently from Abyssinia, Eritrea, or Arabia, and from the north-north-west, possibly from Libya and further westwards, and the progeny of these swarms, which reach maturity in October to November, return in the direction of their origin.

Natural enemies of the adult locusts include various mammals and birds, lizards, snakes, and the more powerful predacious insects. The eggs are attacked

by the larvæ of at least one species of blister beetle, and the hoppers and adults are parasitized by several species of Diptera. The use of a poison bait, which is considered to be the control measure best suited to local conditions, is described.

464. Desert Locust in Eritrea. (*Int. Bull. Plant Prot.*, iv., 11, 1930, p. 161. Abstr. from *Rev. App. Ent.*, xix., Ser. A., Pt. 4, 1931, p. 187.) At the close of the 1929 invasion in Eritrea, great numbers of *Schistocerca gregaria*, Forsk., were destroyed by *Empusa grylli, Isaria* sp., and *Sarcophaga* sp. The swarms, which came mostly from Abyssinia and the Anglo-Egyptian Sudan, were dealt with by means of flame-throwers and poison baits.

465. The Hairy-Chested Locust. (*Uganda Herald*, April 10, 1931.) This species of locust has not previously been recorded in Uganda. It may be distinguished from the Desert Locust by the covering of short dense hairs on its chest (the Desert Locust has a bare shiny chest.) The colour of the young flying locusts is reddish-brown, changing later to greyish-brown. So far, in Uganda, its food has consisted almost solely of wild grasses and grass-like cultivated plants, and cotton has not suffered serious damage.

466. *Chortophila cilicrura*, Rond., a New Parasite of the Migratory Locust in Daghestan. By G. Eberhardt. (In Russian.) (*Plant Protection*, vi., 5-6, 1930, p. 813. Abstr. from *Rev. App. Ent.*, xix., Ser. A., 2, 1931, p. 50.) In Daghestan in October, 1926, egg-pods of the migratory locust (*Locusta migratoria*, L.) were found to contain larvæ of *Phorbia* (*Chortophila*) *cilicrura*, Rond., from 8 to 60 occurring in a pod. In some of the pods all the eggs were destroyed, and the pupæ of the parasite occurred close by in the soil at a depth of 2 to 2½ in. Further examination indicated that the percentage of the parasitized egg-pods varied in different parts of the infested area from 8 to nearly 100. In the laboratory the larval and pupal stages each lasted ten to twelve days. Numerous adults were present in the field from the beginning of October, the weather being very warm and sunny, and swarmed in places where the egg-pods were being dug out. The pupæ were left to hibernate in an unheated room; those taken to the laboratory continued to give rise to adults throughout the whole winter, but the flies did not live longer than ten to fifteen days, even if fed on syrup. *P. cilicrura*, which is well known as a pest of plants, has not apparently been previously recorded as a parasite.

467. The Tarnished Plant Bug, *Lygus pratensis*, L.: A Progress Report. By R. H. Painter. (60th *Ann. Rpt. Ent. Soc., Ontario*, 1929, p 102. Abstr. from *Rev. App. Ent.*, xix., Ser. A., Pt. 1, 1931, p. 38.) Gives the life history of this pest, which has been known to cause injury to cotton. Experiments have also been carried out to determine the phototropic and chemotropic responses, and lists are given of the colours and odours most likely to attract the bug. Applications of contact insecticides in spray and dust form had no apparent effect upon the amount of injury to plants from *L. pratensis*.

468. Tsetse Flies. By I. E. Hegh. (*Les Tsétsés*, Brussels: Belg. Min. Colon., 1919, 1. Abstr. from *Exp. Sta. Rec.*, lxiii., 9, 1930, p. 853.) This work deals with the anatomy, taxonomy, biology and natural enemies of flies of the genus Glossina. Bibliographies accompany the several chapters.

469. Tanganyika. *Tsetse Research. Co-ordination Rpt. No.* 4 of the Dept. of Tsetse Research of the Territory contains an account of the progress made during the period April 1 to September 30, 1930, together with an outline of the programme projected for the period October 1, 1930, to March 31, 1931, at the Stations of Kikori, Shinyanga, and Itundwe.

470. Beizversuche an Baumwollsamen mit den Trockenbeizmitteln Tillantin und Ceresan. (Disinfection Experiments on Cotton Seeds with the Dusts Tillantin R and Ceresan.) By R. Forsteneichner. (*Nachricht. über Schädlingsbekämpf*, v., 3, 1930. Abstr. from *Rev. App. Mycol.*, x., 2, 1931, p. 103.) Cotton seedlings in the Adana region of Turkey are liable to infection by a species of *Rhizoctonia* which is chiefly important as a precursor of various facultative parasites, such as *Gibberella moniliformis, Fusarium scirpi* (*F. gibbosum*), *Rhizopus nigricans, Alternaria* sp., and *Aspergillus niger*. Details are given of a series of laboratory experiments in which excellent control of these organisms was given by dusting the seed with Tillantin R and Ceresan (1,000 gm. per 100 kg. of seed), the latter being particularly efficacious. The practical application of these results under the prevailing conditions of cotton cultivation in Turkey is briefly discussed.

471. Uganda. *Cotton Diseases.* (*Ann. Rpt. of Dpt. of Agr.*, 1929). An account is given of the work on blackarm disease and on the transmission of *Nematospora gossypii* by *Dysdercus* spp. In connection with the latter the results of the 1928-29 season indicate that cotton stainers of this genus, when bred in the laboratory on food containing no trace of *Nematospora*, are not associated with the fungus when transferred later to healthy cotton bolls. Such bolls, when examined two or three weeks later, show only the internal proliferation of the wall tissues, the lint remaining quite healthy. Additional evidence regarding the distribution of *Nematospora* in the field was obtained from the results of these experiments, in which, over a period of a month, when fed on cotton bolls in the field, the stainers were unable to pick up *Nematospora*, and also the fungus was not found in the bolls used for the experiments; thus indicating that the fungus is not common on the external surface of cotton bolls, and that it does not as a rule grow through the punctures made by the insect in the boll wall. The washing of the bolls with $\frac{3}{4}$ per cent. formalin solution in some of these experiments before feeding *Dysdercus* had no effect on the final result.

The full results from the 1929-30 experiments are not yet available, though preliminary indications are that nymphs of the early stages are not able to transmit the disease, after having been fed on a culture of *Nematospora*, whereas older nymphs and adult stainers are able to transmit the fungus from boll to boll. No sign of the fungus has yet been found on or in the insect.

During the 1928-29 season the amount of internal bacterial rot of the cotton boll, as distinct from that due to *Nematospora*, showed a distinct increase over previous years. These bacterial rots often originate from the site of damage due to spiny bollworm (*Earias*), and also frequently from the sutures of the boll, which under some unknown conditions afford ingress into the lock to these pathogens.

472. India. *A Short Note on the Diseases of Cotton Seedlings in the Central Provinces.* By J. F. Dastur. (*Agr. and Live Stock in India*, i., 1, 1931, p. 44.) It has been taken for granted that the mortality among cotton seedlings—which is very heavy in the Central Provinces—is due to wilt, but two other diseases prove to be important in the matter—viz., wet-rot or "damping-off," due to a *Pythium* or to a *Phytophthora*, and dry-rot, caused by *Rhizoctonia bataticola* (Taub.) Butl. The symptoms and appearance of these diseases are described.

473. Studies on the Overwintering of *Phymatotrichum* Root Rot. By J. J. Taubenhaus and W. N. Ezekiel. (*Phytopath.*, xx., 10, 1930. Abstr. from *Rev. App. Mycol.*, x., 3, 1931, p. 186.) This is a comprehensive account of the authors' studies on the mode of hibernation of the causal organism of cotton root rot (*Phymatotrichum omnivorum*) in Texas.

P. omnivorum was found to be viable on overwintered living, infected cotton roots, but not on diseased decayed ones. Cotton plants were successfully inoculated from tap-roots of plants that had succumbed to root rot up to two weeks previously, but not after three weeks. Root rot survives on the roots of many other plants besides cotton. Large numbers of sclerotia were found on newly infected cotton plants in fields apparently free from overwintered roots, thus confirming the work of King and Loomis and of Neal. These organs were also produced in soil chambers in the laboratory and in cultures on synthetic media. The sclerotia germinate readily, and the same individuals may renew growth at least five times under laboratory conditions. Cotton plants were successfully inoculated with a pure culture isolated from a sclerotium and with growth from sclerotia placed directly in the soil, and new sclerotia developed in these containers. The microscopic examination of *Phymatotrichum* spore mats from the field revealed the actual continuity of the spore-bearing hyphæ of the mats with the typical subterranean *Ozonium* growth. Low percentages of germination have been obtained with the spores, but no successful growth or infection from them has yet been secured. A *Hydnum* often associated with plants killed by *Phymatotrichum* root rot does not resemble the latter in pure culture, and no definite connection between the two has yet been traced.

[*Cf.* Abstr. **116**, **252**, and **253**, Vol. VII.)]

474. Soil-Reaction Effects on *Phymatotrichum* Root Rot. W. N. Ezekiel *et al.* (*Phytopath*, xx., **10**, 1930, p. 803. Abstr. from *Rev. App. Mycol.*, x., **3**, 1931, p. 186.) In a series of experiments in which cotton plants inoculated with *Phymatotrichum omnivorum* were grown in soils of varying hydrogen-ion concentrations, the percentages of infection and of plants killed by the disease were higher in soils with alkaline reaction. In acid soils fewer plants were attacked; the average interval between inoculation and wilting was slightly longer; and root rot spread more slowly and less far than in neutral or alkaline soils. A marked diminution of root rot occurred at about P_h 6, while none was present with the soil at P_h 5 to the bottom of the containers, but there was still some in containers with a very acid surface and a slightly alkaline subsoil. The causal organism also overwintered successfully in such containers.

Preliminary tests in the control of cotton root rot by means of sulphur were conducted in the laboratory and in field plots, only the surface layer being acidified in both cases. The incidence of root rot was reduced by applications of sulphur at 5,000 and 10,000 lb. per acre, but not eliminated even with surface soil as acid as P_h 3·4 when the acidity extended only to depths of 3 to 6 in. Acid injury occurred in surface soils adjusted to P_h 2 to 4 even with a neutral or alkaline subsoil. Serious difficulties, therefore, must be overcome before this method of treatment can be generally applied for the control of root rot.

475. A New Nematospora on Cotton Bolls in the Central Provinces (India). By J. F. Dastur and J. Singh. (*Ann. Mycol.*, xxviii., **3-4**, p. 291. Abstr. from *Rev. App. Mycol.*, x., **2**, 1931, p. 101.) A species of *Nematospora* was observed by the writers, for the first time in India, on specimens of diseased bolls from Nagpur, Central Provinces. Such bolls usually show distinct insect punctures, the lint below which is partially destroyed, while that in the surrounding loculi is discoloured, the slight yellowish tinge of the early stages of infection ultimately turning sable-brown. The fungus was invariably found, chiefly in the ascigerous stage, in and on the discoloured fibres. Marsh's description of diseased cotton from Nyasaland may well be applied to the Indian specimens, except that in the former case the walls of the hairs showed no discoloration, whereas in the latter not only the central canal, but also the walls of the cell hairs became yellow or brown. The seeds of infected bolls may be apparently healthy

or may be shrunken and discoloured; even in the former case, however, the presence of the fungus can be detected within the embryo. Inoculation experiments on healthy cotton bolls, cut or attached to plants in the field, with pure cultures of the fungus, gave positive results when the inoculum was placed either on the lines of union of the carpels or on a deep-seated puncture. In glucose agar cultures the hyphæ of the new *Nematospora* are very slender, more so than those of *N. coryli*. There are two kinds of yeast cells, viz., a small, lozenge-shaped type, forming large colonies of many cells, with several buds remaining attached to the mother-cell, and large, globular cells from which the long-elliptical ascus mother-cells develop. The hyaline, elliptical asci, with broadly rounded ends and sometimes a slight depression in the middle, measure 42 to 57 by 7 to 12 μ, and contain eight (occasionally only two or four) uniseptate, long, narrow ascospores, with pointed apices, and the lower end extended into a flagelliform appendage, the ascospore without the appendage measuring 33 to 40 by 2 to 2·5 μ, and the appendage 20 to 32 μ in length. The ascospores germinate by means of a globular swelling near the septum, from which yeast cells are generally developed, though at times germ-tubes may be formed which grow into hyphæ of limited length bearing yeast cells apically and laterally.

The Indian *Nematospora* differs from *N. gossypii*, cultures of which together with *N. coryli* were obtained from London. *N. gossypii* in the authors' glucose agar cultures forms terminal or intercalary asci, sometimes occurring in chains, measuring 53 to 94 by 6·3 to 10 μ, and containing eight or fewer ascospores measuring 35 to 60 by 2·2 to 2·75 μ, with an appendage 34 to 54 μ in length. The corresponding dimensions given by Ashby and Nowell are 70 to 100 by 8 to 12 μ for the asci, 24 to 30 by 2 to 2·5 μ for the ascospores, and 50 to 100 μ for the appendage. The naviculate asci of *N. coryli*, measuring 63 to 114 by 6·3 to 10 μ, contain eight or more ascospores measuring 36 to 60 by 2·0 to 2·7, with an appendage 18 to 46 μ in length. The dimensions given by Peglion are 65 to 70 by 6 to 8 μ for the asci, 38 to 40 by 2 to 3 μ for the ascospores, and 35 to 40 μ for the appendage. On potato slabs the Indian *Nematospora* forms an encrusted cauliflower-like, pure white growth consisting of asci, ascospores, and yeast cells, compared with a flat, feathery development in the case of the two foreign species. The Nagpur fungus is considered to be a new species, for which the name *N. nagpuri* is proposed.

476. INTERNAL BOLL DISEASE OF COTTON IN SOUTH AFRICA. By E. S. Moore. (*Sci. Bull. No.* 94, Dpt. of Agr. S. Afr., 1930.) Internal boll disease in the cotton belt of South Africa is caused in the first instance by micro-organisms, amongst which *Nematospora gossypii* is the most important, whilst *N. coryli* also occurs. The incidence of these two fungi is associated with the punctures of the indigenous species of stainers, which probably act as carriers of infection. Other hosts of Nematospora include beans of several varieties, *Bauhinia Galpini* and *Sterculia platinifolia.*

477. ÉTUDE DE LA PÉNÉTRATION DU CHAMPIGNON *Fusarium vasinfectum* ATK. VAR. ÆGYPTIACUM, T. FAHMY, DANS LES RACINES DU COTONNIER. By T. Fahmy. (*Bull. Soc. Bot. Genève*, xxii., 1931, p. 62.) Commencing with an historical account, in which it is suggested as the result of recent observation that Mit Afifi was a hybrid of the Ashmouni type with Sea Island, it is pointed out that the successive cottons grown in the Egyptian delta have been more and more susceptible to wilt, Sakel being most susceptible.

The wilt parasite and the symptoms of the disease caused by it are described. It has been suggested that it enters the cotton plant by the wounds due to sore shin (*Rhizoctonia*); this also has been studied, and found to infect the plant through the tissues of the hypocotyl, whilst the wilt parasite attacks the roots

primarily in the region of the root cap of the lateral rootlets, though also in other places.

Anatomical studies of the infected tissue are then described, showing the various stages from first infection to destruction of the roots, and are followed by studies of rate of growth in different media.

[And *Cf*. Abstr. 388 above.]

478. Sooty Mould of Cotton and its Control. By S. K. Tzuigankov. (In Russian.) (*Khlop. Delo.*, ix., **9**, p. 1070, Tashkent, 1930. Abstr. from *Rev. App. Ent.*, xix., Ser. A, **3**, 1931, p. 160.) In Central Asia, *Aphis gossypii* Glov. is responsible for the development of sooty mould on cotton, the honey dew produced by the Aphids favouring the growth of the fungus concerned. The latter usually appears in July on the lower leaves and gradually spreads as the Aphids move to the upper parts of the plants, the cotton in the opened bolls being affected in early September. Field experiments against the Aphids with insecticides were carried out in the first half of September, 1929, the concentrations used being rather high in order to study their effect on the cotton fibre. Sprays of 4 per cent. soap or tobacco extract, 1 : 3,000, and a nicotine dust combined with flowers of sulphur were applied at the rate of 180 galls. and 500 lb. respectively, to the acre. Complete mortality was not obtained, though infestation of the leaves decreased on an average by about 50 per cent. The sprays were applied from below, and considerably higher numbers of the pest were killed on the middle and lower leaves. It was found that the insecticides did not affect the quality of the cotton fibre, the soap solution being even beneficial, but though the plants could, therefore, be treated when the bolls are open, it would be more economical to treat them before the fungus had spread to the bolls. The part of the plants on which the Aphids occur should be determined, as this affects the method of applying the insecticide and the quantity required. If *A. gossypii* and the mite *Tetranychus telarius* L. occur together, preference should be given to soap solution or the nicotine dust combined with flowers of sulphur.

479. Bibliographie von *Aspergillus*: 1729 bis 1928. (Bibliography of *Aspergillus*, 1729 to 1928.) By H. Tamiya and S. Morita. (*Bot. Mag., Tokyo*, xliv., **523**, p. 376, **524**, p. 421, 1930. Abstr. from *Rev. App. Mycol.* x., **4**, 1931, p. 211.) An alphabetical list is given of the authors whose works were consulted in the preparation of the bibliography of *Aspergillus* from 1729 to 1928, with the date of publication in each case.

480. The Challenge of Plant Virus Differentiation and Classification. By J. Johnson and I. A. Hoggan. (*Sci.*, lxxiii., **1880**, 1931, p. 29. Abstr. from *Rev. App. Ent.*, xix., Ser. A., Pt. 4, 1931, p. 205.) One of the most useful methods of differentiating plant viruses, which possesses great possibilities for expansion within closely related groups, is that based on the study of insect transmission. The development of such a method, particularly in the case of viruses not readily transmissible by artificial means, may eventually serve to complete a satisfactory key for the determination of plant viruses in general. There are at least three specific conditions affecting transmissibility by an insect, namely, the species of insect involved, the specific virus concerned, and the species of plant serving as a source of infection. Possibly the species of plant liable to infection may add to the possibilities of differentiation. Many cases of specific relationship between the virus and its insect vector are known, and there are others where the relationship is less specific.

481. The Identification of Fungi Causing Mildew in Cotton Goods. The Genus *Aspergillus*, Pt. II. By G. Smith. (*J. of Text. Inst.*, xxii., **2**, 1931, T110.) In the opening paragraph the author writes as follows: " In a previous communication descriptions were given of a number of *Aspergilli* which had been isolated

from cotton goods. A number of the species had been proved to be the causal agents in actual cases of mildew damage, whilst the remainder had been found as common spore infections of commercial yarns, and were regarded as possible sources of trouble. Descriptions of a few forms which were still awaiting identification were omitted from that paper. These all belonged to two groups—the *A. glaucus* series, and a group intermediate between *A. glaucus* series and *A. fumigatus*, having conidia of the type common in the *A. glaucus* series with all other parts of the fruiting organs more akin to *A. fumigatus*. It is proposed to designate this latter series the *Aspergillus penicilloides* group, since it includes *A. penicilloides* Spegazzini and since most of the strains bear a strong resemblance to certain *Penicillia* of the Monoverticillate group (formerly *Citromyces*). During the last two years a considerable number of strains belonging to these two groups have been isolated from mildewed cloths and yarns. In addition, by courtesy of the B.C.I.R.A., a number of cultures isolated at the Shirley Institute have been added to the collection, and an analysis of the whole series is now offered."

[*Cf.* Abstr. 467, Vol. V. of this Review.]

GENERAL BOTANY, BREEDING, ETC.

482. Mechanism of Growth of Cotton Hair. By F. T. Pierce. (*Trans. Faraday Soc.*, **26**, 1930, p. 809. Abstr. from *Summ. of Curr. Lit.*, xi., 7, 1931, p. 185.) The results of chemical, microscopical, and X-ray studies of the fine structure of the cotton hair are reviewed, and the following mechanism of growth is suggested. Three definite stages may be distinguished in the history of growth; first, the formation of the cell in the epidermis of the ovule; secondly, after flowering, the outgrowth of the cuticle to form a very thin tube several thousand times as long as the diameter, which changes little; thirdly, the deposition of secondary thickening to form a strong cell wall. The complete reaction of deposition of a molecule of the soluble carbohydrate to the state of structural cellulose involves the formation of linkages in three directions, (l) along the spirillæ, (t) transversely between spirillæ in a cylindrical sheet, (r) radially between concentric layers. In the third stage all three are active; in the second stage the first two; and it is suggested that the first only is operative in the first stage. In the first stage the elementary filaments form and grow, one molecule or "chain" thick, without the power to cohere rigidly. In the primary deposition on a cell cuticle, the coagulation is highly localized and probably controlled by protoplasmic streaming which will most naturally close-pack the filaments with tangential orientation. Regarded as a continuous line, they thus form an irregular spiral with random reversals. After flowering, and particularly on fertilization of the ovule, the growth of the latter is stimulated, and it is reasonable to presume an increase in osmotic pressure which forces the spiral outwards. At this stage it is supposed that the second linkage (t) becomes active, and the original spiral is reproduced by deposition, in the same surface, of other spirals, one after another. After about four weeks, the stage of outgrowth ends and secondary thickening begins. At this point the (r) linkage becomes active, reproducing each spiral of the primary wall by apposition. The resultant structure is continuous and regular on the whole, but the large unsaturated molecules allow of local interplay between the ideal of the molecular forces and the actualities of the cell-wall surface, between crystal and hair form.

483. Cotton Leaf: Anatomy. By M. and E. Magitt. (*Bot. Centr.*, xvii., 1930, p. 323. From *J. Soc. Bot. Russie*, xiv., 1930, p. 191. Abstr. from *Summ. of Curr. Lit.*, xi., 7, 1931, p. 185.) The leaves of American cotton plants have the usual leaf structure with a palisade layer and lower spongy layers. The leaves of cotton plants of the Old World have an upper and a lower palisade

with only a little spongy parenchyma in between. The leaves of hybrids of the two types have merely one upper palisade. Some wild cotton plants show isolateral palisade structures and others the ordinary type.

484. GENETICS OF COTTON: A SURVEY OF OUR PRESENT KNOWLEDGE. By T. H. Kearney. (*J. of Hered.*, xxi., Nos. 7, 8, and 9, 1930, pp. 325, 375, 409.) This is an excellent survey of the present position which should be in the hands of every worker. The writer commences by showing that very few characters have as yet been proved to be inherited in a definite alternative way, partly because such characters as boll size or lint length, in which breeders are interested, are conditioned by several factors, and partly because a great deal of the work has been done with species crosses. A list is given of all proven, or strongly indicated allelomorphic characters, and includes only fourteen, which are:

Plant "crinkle leaf dwarf," plant normal.
Short branch, normal branch.
Chlorophyll locally deficient, chlorophyll evenly distributed.
Leaf colour red, leaf green.
Leaf lobes narrow (okra leaf), leaf lobes wide.
Petal colour whitish, petals yellow.
Petal colour whitish or yellow, petals red.
Petal spot absent or weak, petal spot strongly developed.
Pollen colour whitish, pollen yellow.
Boll apical furrow present, furrow absent.
Seeds fuzzy, seeds naked.
Seeds entirely fuzzy, seeds fuzzy at tip.
Seed fuzz white, seed fuzz green.
Seed fuzz white, seed fuzz brown.

Details are then given of each of these, with references to the original papers. The writer points out how little evidence of linkage has been obtained, and concludes the paper with the remark that "scarcely a beginning has been made in fixing the location of the genes." A useful bibliography of fifty titles is included, of which it may be noted that fourteen are by Harland and six by the author himself.

485. PLANT-BREEDING ABSTRACTS. The Imperial Bureau of Plant Genetics has begun to issue a publication entitled *Plant-Breeding Abstracts* in which all the more important current publications dealing with plant-breeding and the genetics of crop plants are listed. The references are classified according to subject, and each reference is followed by an abstract indicating the subject-matter of the paper and the results obtained. The papers are divided into two halves, those published in the British Empire and those published in foreign countries. Papers written in foreign languages are usually abstracted somewhat more fully than papers in English.

Plant-Breeding Abstracts is issued quarterly, and Vol. I., No. 3, which was published on April 1, 1931, contains 197 references covering 52 pages. The annual subscription for the publication is at present 5s. post free, single copies being obtainable at the price of 1s. 6d. Subscriptions should be sent to the Deputy Director, Imperial Bureau of Plant Genetics, School of Agriculture, Cambridge, England.

486. THE GENETICS, BREEDING, AND IMPROVEMENT OF CORN AND COTTON. By C. K. McClelland. (Pubd. by the Compiler, Univ. of Arkansas, Fayetteville, Ark., 1930. Price of combined lists on corn and cotton $1.00 post paid; references on cotton alone, 60 c.) A bibliography covering more than forty years' work (1889-1929) on the breeding, improvement, and study of inheritance in corn and cotton.

487. NEW PRINCIPLES IN PLANT-BREEDING. By von Gescher. (*Int. Rev. Sci. Pract. Agr.*, xxii., 1, 1931, p. 4. Abstr. from *Plant-Breeding Abstracts*, i., 3, 1931, No. 301.) An account of the new methods evolved by the Institute of Applied Botany in Russia, involving the discovery of the centres of distribution of the various crop plants, the law of homologous variation, and its significance for the breeder, the significance of the cytological findings, and of chromosome doubling in the elucidation of old phenomena and the production of new types.

488. WORK ON INTERSPECIFIC HYBRIDIZATION IN COTTON AT THE TURKESTAN BREEDING STATION. By K. Vycotski. (*Bull. Sci. Res. Cott. Inst. Tashkent*, i., 1930, p. 26. Abstr. from *Plant-Breeding Abstracts*, vol. i., 3, 1931, No. 383.) The object of the enquiries has been to investigate the possibility of obtaining constant hybrids in wide crosses, which unite the valuable lint characters, yield, earliness, etc., of the respective groups. The new-world cottons, which seem to be natural tetraploids, are much superior both in yield and vigour and in lint quality.

Three species took part in the 1929 crosses—viz., *G. hirsutum*, *G. barbadense*, and *G. herbaceum*—the object being to combine in one variety the valuable lint character of the Egyptian (*G. barbadense*), and the earliness, strength of lint, and high yield of the uplands (*G. hirsutum*); and to produce from the cross *G. herbaceum* × *G. hirsutum* reliable drought-resistant productive types with hairy bolls. In all, seventy-five lines were used, and 75,000 to 80,000 pollinations were made.

Preliminary observations show that crosses of groups with the same chromosome number are very easy. Crosses between new and old-world forms—*i.e.*, groups with different chromosome number—succeed extremely seldom, certain combinations giving a higher percentage of success than others; this occurs also in crosses of the same chromosome number. Thus, out of 1,000 crosses of No. 169 (Upland type) with No. 0671 (*G. barbadense*) 9,330 hybrid seeds were obtained, whilst with No. 0100 (*G. hirsutum*) the same number of crosses gave 3,328 hybrid seeds.

That natural crossing between varieties belonging to different chromosome groups also occurs, even without emasculating the female plant, was shown by certain cultures specially arranged to test this point. The author mentions the results of a number of writers with regard to natural crossing, and the factors which influence it, but is unable to agree with Dekaprelovitsch that it depends on the variety of cotton.

The percentage of natural crossing between varieties with different chromosome number was not more than 0·003 per cent. All the F_1's obtained were sterile, both when self-pollinated and back-crossed. Various methods for obtaining later generations are being tried, including the action of certain narcotics. Methods of utilizing the F_1 plant, of improving methods of hybridization, and finding the most suitable combinations, are in progress.

489. HYBRIDIZATION IN COTTON. By A. H. Zhurbin. (*Bull. Sci. Res. Cott. Inst. Tashkent*, i., 1930, p. 22. Abstr. from *Plant-Breeding Abstracts*, vol. i., 3, 1931, No. 384.) The percentage of natural hybridization found by various workers is tabulated and discussed. It is shown to depend very largely on the spacing, the weather, and the variety of cotton. Attempts to breed absolutely self-fertilized types, by breeding short style and other methods, have failed. A very short résumé of the history of cotton hybridization is given, ending with a short account of the work of Zaitzev in combining the quality of lint of American cottons with the early ripening necessary for cultivation in Turkestan.

490. COTTON INHERITANCE STUDIES: LINT PERCENTAGE. By J. F. O'Kelly and W. W. Hull. (*Miss. Sta. Tech. Bull.* 18, 1930. Abstr. from *Exp. Sta. Rec.*, lxiv;

3, 1931, p. 214.) The inheritance of lint percentage was studied in the F_1, F_2, and back-crosses of hybrids variously involving inbred strains of Cleveland (pure for low percentage and fuzziness), Half and Half, Miller, Okra Leaf, Trice 78 and 78F, and Sea Island cottons.

In cases where the segregation was well defined, lint percentage appeared to be controlled by a single factor pair and high percentage partly or completely dominant. The nature of the segregation could not be determined definitely in interspecific crosses and in crosses between Upland strains, where the percentage differences were narrow.

491. Biometrical Analysis of Upland Cotton Grown at Stillwater, Oklahoma. By F. Griffee *et al.* (*Exp. Sta. Bull. No.* 187, 1929, A. and M. Coll. Agr. Exp. Sta., Oklahoma.) A review is given for the correlation studies in cotton, and correlation coefficients are calculated from published data of variety tests in a number of localities of the cotton belt. The four characters given emphasis in these studies are the yield of seed cotton, the lint per cent., the lint length, and the size of boll. There is considerable variability in the degree of association among these four characters as expressed by their correlation coefficients. The correlations vary from year to year and from one locality to another, with the exception of the two characters, lint length and lint per cent. These two are negatively correlated in all years and in all sections. In several instances the relation is sufficiently close to be of value in predicting one character from values of the other.

The summary goes on to give further detail.

FIBRE, YARN, SPINNING, WEAVING, ETC.

492. British Cotton Industry Research Association. (*Rpt. of Dpt. of Sci. and Indus. Res.*, 1929-30, p. 141.) The area covered by the buildings of the Shirley Institute has been nearly doubled by the erection of the technological department. An important section of the work undertaken in the new department is the performance of spinning tests on cottons produced by the Empire Cotton Growing Corporation.

The most pressing problem awaiting solution by the Institute is that of finding some method by which the spinning value of a cotton can be predicted from a laboratory examination of the raw material. Next in order to be considered are investigations to determine how the efficiency of weaving and the market value of cloth are affected by (1) the quality of the warp yarn; (2) the nature of the warp-sizing process; and (3) machinery conditions, such as the rate of weaving and the tension on the warp threads in the loom.

Research work has also been carried out on the fastness of dyestuffs to bleaching, on the elastic properties of cotton, the absorption, transmission, and reflection of radiant heat by cotton fabrics, the transfer of moisture through fabrics, the swelling of cotton cellulose, and the measurement and description of colour.

493. Textile Microscopy. By H. Ellis. (*Text. Rec.*, xlviii., 576, 1931, p. 26.) Deals with the microscopy of cotton hairs.

494. Fibre Projection Microscope. By B. Schulze. (*Papier-Fabrikant*, xxix., 1931. Abstr. from *Summ. of Curr. Lit.*, xi., 5, 1931, p. 122.) The disadvantages of the usual method of measuring the dimensions of fibres by means of the microscope are pointed out, and a simple projection apparatus is described. Notes are given on the method of making measurements and on the preparation of the fibre samples.

495. FIBRE CONTOUR INSPECTION INSTRUMENT. By S. G. Barker and M. H. Norris. (*J. Scient. Instr.*, 7, 1930, p. 22. Abstr. from *Summ. of Curr. Lit.*, xi., 4, 1931, p. 94.) The device enables a fibre to be examined at all points along its length, and at the same time to be examined completely at any point by rotating it through 360°. The fibre is held at each end by a special type of "chuck." The chucks can be rotated equally and simultaneously, and the degree of rotation is shown on a graduated scale. The bed of the instrument is such that the fibre can be moved laterally without disturbing its position in the chucks. The apparatus is mounted so that the fibre occupies the position of the galvanometer string in the optical system of an Einthoven galvanometer, and thereby an image magnified up to 500 or more diameters can be secured. A small right-angled prism on the eyepiece end of the instrument projects the image horizontally. The instrument is useful in affording a complete measure of the fibre previous to testing for elasticity, etc., since it leaves the fibre unimpaired.

496. COTTON YARN: INFLUENCE OF MOISTURE ON TENSILE PROPERTIES. By C. F. Goldthwait. (Papers presented at Spring Meeting of Textile Res. Coun., 1929. Abstr. from *Summ. of Curr. Lit.*, xi., 7, 1931, p. 178.) Tests were made on 2/40 combed peeler yarn of ordinary mercerizing twist. The strength of an ordinary warp-mercerized yarn was practically constant through a range of regains from 3¼ to 12½ per cent., which covers the ordinary range of humidity; and about one-fourth greater for actual wet material. The unmercerized yarn gained about one-third of its normal strength during a similar moisture increase (2¾ to 10 per cent. regain) corresponding to a change of 4·7 per cent. in strength for each 1 per cent. difference in regain within the above range. It gained another third on wetting. Through the same ranges of regains the elongations-at-break showed a gain of 40 per cent. for the mercerized yarn and 50 per cent. for the unmercerized. These figures correspond to 0·02 per cent. and 0·5 per cent. actual elongation to be added or subtracted for each gain or loss of 1 per cent. regain. The wet yarns had appreciably higher elongations. Mercerized yarn is commonly stronger than unmercerized, the difference being much greater with dry yarns. A statement that mercerized yarn is stronger than unmercerized by any definite amount must, to be useful, be accompanied by some indication as to humidity or regain.

497. A STUDY OF COMPARATIVE RESULTS FOR LEA, SINGLE THREAD, AND BALLISTIC TESTS ON YARNS FROM STANDARD INDIAN COTTONS. By A. J. Turner and V. Venkataraman. (*Tech. Bull. Ser. B.*, *No.* 12, Indian Central Cotton Committee, 1930.) It is pointed out that while the lea test suffers from the disadvantages, that in practice yarn is seldom treated in lea or hank form, and that the test-results are difficult to interpret, it has three great advantages in (1) being popular (2) involving a comparatively small sampling error, and (3) providing the specimens required for the determination of counts. The single-thread test suffers from none of the objections to the lea test, and, moreover, it yields a result for the extension of the yarn; but, as ordinarily carried out, it involves a much greater sampling error. The advantages claimed for the recently developed ballistic test are also examined, reference being made more particularly to the work of Lester, Midgley, and Peirce. In the comparison of the lea and single-thread tests reference is made to the work of Bowman, Gégauff, Corser and Turner, G. R. Smith, and W. J. Hall.

The testing of the standard Indian cottons has provided an opportunity of comparing the three methods of testing on an extensive scale. Results are available for twenty-two cottons of 1926-27, 1927-28, 1928-29, and 1929-30. The total number of tests made was 20,700 for lea strength and counts, 20,700 for ballistic work and counts, and 82,800 for single thread strength and counts. The ballistic tests have been made in two series, one with the ends of the lea free to move round the fixing rods, and the other with the ends fixed.

The results for the various tests are discussed in the form of their ratios to one another. The ratio of lea count-strength product to ballistic count-work product varied from 0·32 for 6/10's to 0·51 for 20/40's when the lea ends were free to move; and from 0·41 for 6/10's to 0·63 for 20/40's when the ends were fixed. These differences for various counts are due chiefly to differences in yarn-extension, although the degree of the twist also appears to be a factor of importance. The higher counts give slightly lower values for the ratio of lea count-strength product to single-thread count-strength product, but no general rule is deducible. The ratio of the single-thread count-work product to the ballistic count-work product is also variable, but is distinctly higher when the lea ends are fixed in the ballistic tests, under which conditions it ranges from 0·87 for 6/10's to 0·79 for 20/40's. The irregularity of the results is decidedly less for the ballistic test than for the lea test, but much greater for both than for the single-thread test, when due allowance is made for the difference in the numbers of threads tested; the greater regularity of the results obtained by the ballistic test is somewhat discounted by the fact that they are much more affected by changes of humidity.

The three methods of testing are also compared by placing the staple cottons of each season in their order of rank according to each test. It is found that all the tests agree fairly well together, but whereas the differences between the lea strength and single-thread strength results are negligible, the differences between ballistic strength results and those of the other tests are more serious.

The conclusion is finally reached that, though there is not sufficient evidence available at present to justify a recommendation that the lea test should be discarded in favour of the ballistic test, yet the latter is a good test of yarn and worthy of a much more extended examination.

498. The Determination and Variation of Twist in Ring-Spun Cotton Yarns. By D. F. Kapadia and A. J. Turner. (*Tech. Bull. Ser. B., No.* 13. Indian Central Cotton Committee, 1930.) In the present paper it is pointed out that the determination of twist in single cotton yarn is a matter of considerable difficulty, especially when the yarn has been spun from a short staple cotton. Large numbers of tests have been made on single yarns by the usual method of removing the twist in a Standard Twist Tester.

A new method of twist testing is described which consists of passing two single yarns between the front rollers of the ring frame and spinning in the usual way, so that the total doubling twist is substantially the same as in an equal length of single spun yarn. Twist tests on twofold yarns can be made with very great accuracy, using 10-in. lengths, and this method has therefore been employed for the purpose of investigating the variation of twist throughout the bobbin, and also for ascertaining if the variation of twist is affected by the variations in the winding-on tension or by variations in counts.

In an Appendix some results are given of certain observations on the relation between the spindle speeds as observed by means of a tachometer and as calculated from the front roller speed, also measured by a speed indicator.

The experiments have been carried out on Punjab-American 285 F. spun into single yarns of 20's, 30's, and 40's counts, and also made into twofold grandrelle yarns of 2/40's, 2/60's, and 2/80's counts. The results of a large number of other tests on the standard Indian cottons have also been analyzed in arriving at the conclusions, which are as follows:

(1) When single yarns are tested for twist by the ordinary method it is necessary to make at least 100 observations on 1-in. lengths in order that the odds may be 5 to 1 that the mean value is correct within 2 per cent. on either side of the mean.

(2) When a grandrelle yarn is made above a single yarn on the same bobbin

by doubling together two single yarns, under the same spinning conditions as those employed in the spinning of the single yarn, only ten determinations of twist in 10-in. lengths need be made on the grandrelle yarn in order that the odds may be 10 to 1 that the mean value is correct within 2 per cent. on either side of the mean.

(3) The practice at the Technological Laboratory of making ten tests on the grandrelle yarn spun at the top of each of ten bobbins enables the checking of the correctness of the twist wheel to be carried out to a very high degree of certainty.

(4) While the insertion of twist leads to a contraction of the yarn during spinning, this may be partly offset by an extension due to the effect of the winding-on tension.

(5) In calculating the twist per inch in the yarn from the "constant dividend" for twist, the allowance which is made for the thickness of the spindle bands and band slippage should be 8·5 per cent.

(6) Any effect on the twist per inch of a difference in the winding-on tension at the apex and base of the chase appears to be completely masked by irregularities due to other causes.

(7) Very little variation should exist in the total twist of successive long lengths of yarn wound on the bobbin; where such differences do exist they indicate the existence of variation either in the winding-on tension or in the spindle-band tension during spinning.

(8) The variation of twist in successive 6-inch lengths of yarn is chiefly conditioned by the variation of count along the yarn.

499. Cotton Spinning Machinery: Improvements. By H. Hill. (*Text. Weekly*, **6**, 1931, p. 586. Abstr. from *Summ. of Curr. Lit.*, xi., **7**, 1931, p. 167.) An account is given of recent improvements in blowing-room installations, high draft ring spinning, large package ring spinning, and automatic bunching motions.

500. Cotton Machinery: Lubrication. By L. A. Baudoin. (*Text. World*, **78**, 1930, p. 2699. Abstr. from *Summ. of Curr. Lit.*, xi., **3**, 1931, p. 68.) The care of textile machinery and the difficulties of lubrication caused by the design of old types of machines are discussed. The characteristics of oils required for textile machinery lubrication are briefly described, and a list is given of the machines used in cotton mills.

501. Textile Machinery: Developments, 1930. (*Mech. Eng.*, liii, 1931, p. 44. Abstr. from *Summ. of Curr. Lit.*, xi., **5**, 1931, p. 111.) A report by the Textile Division of the American Society of Mechanical Engineers on some of the more important developments in textile engineering during the year 1930. One of the principal advances of the year as regards cotton machinery is said to be the continued gain in popularity of one-process scutching. Mention is made of the Shirley card. American spinners are reaching counts as fine as 140's-200's, and there is a noteworthy trend towards combed yarns. During the year two major research organizations have been created, namely, the United States Institute for Textile Research, in which the Textile Research Council and the American Association of Textile Chemists and Colourists have merged their interests, and the Textile Foundation, created to administer, in textile research, the major portion of the 1,800,000 dollar fund derived by the Textile Alliance from the sale of German reparation dyes.

502. High Drafting: Spinning Direct from Slubbing. By H. Spibey. (*Int. Cot. Bull.*, ix., **35**, 1931, p. 401.) Describes the Nigrin system of spinning, with illustrations of the Patent Nigrin Slubbing Frame and Ring Frame.

503. High Drafting Systems. By J. H. Dawson. (*Text. Merc.*, **84**, 33 and 53, 1931. Abstr. from *Summ. of Curr. Lit.*, xi., **5**, 1931, p. 111.) In a discussion of some high drafting systems, the author quotes the results of tests which show that there is an advantage in employing four lines of rollers as against three lines, even when using only the ordinary draft. The figures show also that there is a decided falling off in yarn quality between ordinary drafted and high drafted material when four lines of rollers are used in both cases. The results of some tests made in 1924 to ascertain the behaviour of poor quality short stapled Indian and other cottons under high drafting are recorded, and attention is drawn to the advances made since that date. Particulars of rollers and settings for Indian and American cottons up to $\frac{11}{16}$ in. and for Egyptian $\frac{11}{16}$ in. and upwards are given.

504. Random and Systematic Selections of Warp Specimens in Cloth-Sampling. By A. J. Turner. (*J. of Text. Inst.*, xxii., **2**, 1931, T77.) This note discusses the relative merits of systematic and random methods of selecting warp specimens from a sample of fabric, when both selections are made on the Latin-square principle. Reasons are given for the belief that the distribution of specimens in the fabric itself is already random, so that the random selection would only show to advantage in the particular case of the random distribution where the specimens were arranged periodically, and where, moreover, the periodical selection by the systematic method happened to coincide with the periodical arrangement. A comparison of the methods of sampling is made in the case of three fabrics—two cottons and one linen; from each of these fabrics 256 warp specimens had been taken, sixteen from each of sixteen adjacent warp strips, and tested for strength; an analysis of the strength-values shows that, for these three fabric samples, the random selection does not lead to any better results than the systematic, thus supporting the conclusion arrived at from purely general considerations. At the same time it is recognized that from a purely theoretical point of view the random method of selection retains its superiority, and that it is therefore better to adopt the random method unless there are cogent practical reasons for adopting the systematic method.

505. Cotton Mills: Construction and Equipment. (*Text. World*, **79**, 1931, p. 641. Abstr. from *Summ. of Curr. Lit.*, xi., **8**, 1931, p. 212.) A review of American developments in textile mill construction, power supplies and heating, ventilating and conditioning equipment, presenting the opinions of experienced engineers.

506. Mill Costings System. (*Spinn. u. Web.*, xlviii., **52**, 1930. Abstr. from *Summ. of Curr. Lit.*, xi., **5**, 1931, p. 140.) It is shown that the periodic balance may give false impressions of progress owing to changes in prices of raw materials, and a comparison on a goods basis instead of a gold basis is recommended. Expenses and important items in costs of production are discussed.

507. Progressive Stages of Loom Development—I.-V. "Tuner." (*Text. Argus*, **7**, 1930. Abstr. from *J. of Text. Inst.*, xxii., **4**, 1931, A183.) Great improvements have been made in every stage of machine making, and these are all concentrated in the modern loom. John Kay's fly shuttle was followed in 1760 by Robert Kay's drop box. This invention was as revolutionary for fancy fabrics as the fly shuttle for the plainer pieces. In 1786, Cartwright began a series of experiments which culminated in the invention of his power loom. The ideas he incorporated are the foundation upon which the modern power loom is built, and though many parts and motions have been added, none of those which he introduced can be left out. The "Wiper" loom, made by Miller about

1800, was followed by the earliest tappet loom, and by the automatic temple in 1805. Three modern methods of securing the eccentric movement of the going part are given, and the making of the sley described, a comparison being drawn between old-fashioned and modern methods. The Jacquard loom (first introduced into England in 1820) was specially constructed for the weaving of fancy figures and of lightweight fabrics, in contrast to the dobby loom. Also in 1820 Bowman brought out his improved tappet loom. The operation of the Woodcroft tappet is described. The loose reed loom brought out by Hornby and Kenworthy in 1834 is compared with the modern developments of the same principle. The weft fork motion, first invented in 1831, was greatly improved, until in 1842 Bullough practically left it as we have it today. The principles of the circular box motion were first invented in 1843, and have continued from that time onwards for the dress goods trade. By 1845, Squire Diggle's drop box motion was an accomplished fact. This was followed by the Eccles box motion and the Knowles motion. The cone overpick motion is described with special reference to the picking shaft and the toothed brackets. The "pick and pick" arrangement now takes three forms, the horizontal slide, the vertical slide, and the catch pick. It was inevitable that, when marked improvements had been made in the picking arrangements, attention should be directed to the making of a dobby. The Blackburn dobby was made by Railton and Lang in 1858, the Keighley dobby by Messrs. Hattersley and Smith in 1867, the Knowles dobby was brought out in 1874, and in 1884 the first cast-iron dobby made its appearance. The **V** dobby is the most successful application to which the cast-iron dobby has been applied.

508. The Advantages of Automatic Looms. By H. deG. Gandin. (*Text. Rec.*, xlviii., **577**, 1931, p. 36.) Deals with the advantages to be gained by the use of Northrop looms, the type of weaving shed required for their installation, the lay-out of the machinery, and the number of looms per weaver.

509. Automatic Looms: Application in Lancashire. By W. A. Hanton. (*Text. Weekly*, **6**, 1931, p. 617. Abstr. from *Summ. of Curr. Lit.*, xi., **8**, 1931, p. 204.) A discussion of the attitude of Lancashire manufacturers and operatives toward automatic weaving, and of problems relating to systems of payment, double shifts, the rewinding of weft, and the lack of adaptability of automatic looms.

510. Automatic Looms. By R. Burgess. (*Text. Rec.*, xlviii., **576**, 1931, p. 36.) A comparison of the "non-stop" and "stop" automatic looms.

511. Shuttleless Loom. By Br. Celanese, Ltd. (London), and F. C. Hale. (E.P., 341,142 of 23/10/29. Abstr. from *Summ. of Curr. Lit.*, xi., **8**, 1931, p. 205.) Means for measuring weft from a stationary supply at the side of the loom in the form of a loop sufficient for two picks, are used in combination with weft-inserting means adapted to engage each limb of the loop in turn, and carry it part-way through the shed, and with means for transferring the weft thus inserted to withdrawing means adapted to carry it through the remainder of the shed. Details of the mechanism are given. A rapid beat-up is obtained from a cam mounted on the crankshaft, and of such contour that the lay is retained in its rearmost position for the major portion of the revolution of the crankshaft, to allow sufficient time for the operation of the weft inserters.

512. Fabrics Research. (*Rpt. of Dpt. of Sci. and Indus. Res.*, 1929-30, p. 36.) The most interesting investigation described in the Second Report of the Fabrics Co-ordinating Research Committee is in connection with the use of borax-boric acid mixtures for the fireproofing of fabrics. It was found in the course of the

work that the addition to a "4-oz." cotton fabric of 6 per cent. of a mixture containing 30 per cent. of boric acid and 70 per cent. of borax was effective in fireproofing the material.

513. A Portable Instrument for Measuring the Air Permeability of Fabrics. By H. F. Schiefer and A. S. Best. (*Bur. Standards J. Res.*, **6**, 1930, p. 51. Abstr. from *J. of Text. Inst.*, xxii., **3**, 1931, A156.) A self-contained instrument for measuring the flow of air through fabrics is described. The specimen to be tested is clamped between two orifice rings under a slight tension. Air is drawn through the fabric and through a calibrated orifice meter by a suction fan. The pressure drop across the fabric and across the orifice meter is measured respectively by inclined and vertical gauges. The volume of air passing through the fabric at a given pressure drop is thus obtained. With a set of nine orifices ranging in diameter from 1 to 16 mm. the flow of air may be measured for a wide variety of fabrics, ranging from closely woven to loosely knit constructions. For a specimen of cloth tested by this instrument it is shown that the variation in air permeability, because of the non-uniformities in the cloth, is greater than the experimental uncertainty.

514. Cotton Fabrics: Chemical Finishing Processes. By C. Thibaud. (*Tiba*, **8**, 1930, p. 1457; **9**, 1931, p. 35. Abstr. from *Summ. of Curr. Lit.*, xi., **7**, 1931, p. 175.) A review of patent chemical finishing processes for the production of transparent, opal, wool-like and other effects on cotton.

515. Immunized Cotton. By H. Wolf. (*Text. Rec.*, xlviii., **577**, 1931, p. 63.) Describes the processes involved in the production of "immunized" cotton, and the uses to which it can be put.

MISCELLANEOUS.

516. Report of the Cotton Mission, 1930. (Pubd. H.M. Stat. Off., 1931. Price 1s. net.) The Cotton Mission was appointed to assist the British Economic Mission to the Far East, and to state what action should be taken to improve British trade in cotton goods. The report contains an account of the visit of the Mission to China and Japan, and the recommendations made as the result of the visit.

517. Report of the British Economic Mission to the Far East, 1930-31. (H.M. Stat. Off., 1931. Price 2s. 6d. net.) After describing the visit of the Mission to China and Japan, the report deals with the present condition of British trade with those countries, and states what action should be taken to increase that trade.

518. "*Commercial Oldham.*" The "British Cotton Textile Exhibition Number" of this journal contains a number of interesting short articles, among which we may mention: "The Need for Co-operation," by Rt. Hon. J. R. Clynes; "Combines in the Cotton Trade," by Sir Kenneth D. Stewart; "Why not New Industries for Lancashire?" by F. J. Marquis; "The Outlook for Egyptian Spinners," by W. Howarth; "Disequilibrium, not Shortage of Gold," by A. M. Samuel, M.P.; "Research in the Cotton Industry," by Dr. R. H. Pickard; "The Case for Safeguarding and Empire Economy Unity," by Brig.-Gen. Sir Henry Page Croft; "Can the Cotton Trade be helped by Protection?" by R. Muir; "Statistical Methods for Forecasting Raw Cotton Prices," by W. H. Slater.

519. The Microscopic Examination of Cattle Foods. By S. T. Parkinson and W. L. Fielding. (Headley Bros., Ashford, Kent, 1930). The general object kept in view in the preparation of this book is described in the preface by Dr.

Voelcker: "I can welcome the appearance of a work dealing in a practical way with the preparation of material for, and the appearances presented by, a large number of the more commonly occurring seeds and substances met with in the ordinary experience of an agricultural analyst, and which necessitate—for their recognition—the use of the microscope." Dr. Voelcker describes the book as largely free from the errors liable to be made in dealing with mixtures of materials.

After a chapter dealing with the methods employed in the preliminary examination and preparation of fragments for, and the use of, the microscope, cutting of sections, etc., the remainder of the book is devoted to the details of structure, staining reactions, etc., of oil-containing plants, cereals, legumes, and miscellaneous plants. Cotton-seed cake is dealt with on p. 13, and good photographs are included of fragments of cotton seed, together with full descriptions. Tables of comparison are given for each group, and the book, which is profusely illustrated, concludes with a selection of the published literature on the subject.

520. Raw Cotton: Supplies and Prices. (*Text. Merc.*, 1931, 41st Ann. Trade Rev. Suppl., Abstr. from *Summ. of Curr. Lit.*, xi., 8, 1931, p. 222.) The movements in raw cotton prices in 1930 are traced, and statistics are given for the crops of Egypt, America, and the British Empire. In regard to the Empire crops, Sudan Sakel, East African, and white West African cottons have now built up a deservedly high reputation and are produced in commercial quantities. There has been an increasing use of Empire cottons and also of Brazilian and Peruvian cottons.

521. Cotton Piece-Goods: Trade in 1930. (*Text. Weekly*, 6, 1931. Abstr. from *Summ. of Curr. Lit.*, xi., 5, 1931, p. 140.) Statistics of the exports of various classes of piece-goods to India, the Far East, European countries, British Colonies and Dominions, America, and the Near and Middle East are given for 1921, 1929, and 1930. The causes of the decline in the different branches are discussed.

522. Cotton Year Book, 1931. Pubd. by the Textile Mercury Ltd. M/c. Price 7s. 6d. Abstr. from *J. of Text. Inst.*, xxii., 4, 1931, p. 43.) The twenty-sixth edition again furnishes interesting matter. All sections have been revised. The last section—Trade Associations, etc.—in its revised state is, as always, extremely useful in that it is a special feature of this series of year books.

ADDENDUM.

523. The Wall of the Cotton Hair. By C. H. Brown, Abd el Ghaffar Selim, and W. L. Balls. (*Nature*, vol. cxxvii., No. 3211, 1931, p. 742.) Measurements of dimensions of cotton hair cross-sections show several features of interest when correlation diagrams are plotted between cell-wall thickness and ribbon width (maximum diameter of collapsed cell tube). The correlation axis tends to follow the curved lines of equal cross-sectional area—that is to say, that the volume of cellulose-forming material which enters each cell would be approximately constant if the cells were of equal length. Another result of importance relates to the question of nep, which is predominant in cells of large diameter and absent in those of small. It is pointed out that caution must be used in translating these data into terms of growth and development, but the results are of considerable importance and will repay study.

PERSONAL NOTES

We much regret to announce the death of Sir Edmund Bartley-Denniss, which occurred on March 20 at his home at Uxbridge. Sir Edmund Bartley-Denniss represented the London Chamber of Commerce on the Council of the Corporation.

APPOINTMENTS.

SUDAN.

Mr. M. A. Bailey, the Corporation's Plant Breeder in the Sudan, has resigned from the service of the Corporation to take up an appointment with the Sudan Government as Controller of Agricultural Research. This post was created by the Government in order that the task of co-ordinating the agricultural research work might be in the hands of one officer, and in view of the importance of the work involved the Corporation expressed their willingness that Mr. Bailey should accept the appointment, though they anticipated some difficulty in finding as his successor anyone with his experience. They are glad to report, however, that the post has been accepted by Mr. T. Trought, Cotton Botanist, Punjab, a former colleague of Mr. Bailey in Egypt, where he had considerable experience of cotton-growing under irrigation.

OFFICERS ON LEAVE.

When an officer of a colonial Department of Agriculture (or of the allied departments of Irrigation, Transport, etc.) comes "home" on leave, he usually brings with him much information that may be of considerable value to similar officers in other colonies, or to the officers of the Empire Cotton Growing Corporation, who have to collect, collate, and use all possible information relating to cotton. The Corporation would consequently much appreciate the courtesy if Directors of Agriculture and others would be so kind as to inform them, in advance if possible, of the names, probable addresses, and approximate dates of arrival in England of officers coming on leave. This would give the Corporation the opportunity of getting into touch with these officers themselves, and of giving the latter the opportunity of meeting with one another. A further courtesy would be conferred if the officers themselves, upon arrival, would call at, or inform, the offices of the Empire Cotton Growing Corporation, which are at the corner of Millbank and Wood Street (entrance by the first door in Wood Street), immediately opposite the offices of the Crown Agents for the Colonies.

At the date of writing, the following officers are on leave or will shortly be arriving in England from cotton-growing countries:

British Guiana	Mr. E. Beckett.
Ceylon	Mr. N. K. Jardine.
Gold Coast	Mr. A. B. Cullam.
" "	Mr. G. H. Eady.
" "	Mr. H. K. Hewison.
" "	Mr. G. G. Auchinleck.
" "	Mr. H. Nicholas.
" "	Mr. A. W. Paterson.
" "	Mr. J. T. H. Stein.
" "	Mr. A. S. Thomas.

Gold Coast	Mr. T. L. Williams.
,, ,, ...	Mr. J. M. Wingate.
,, ,, ...	Mr. J. Wright.
India	Mr. B. C. Burt.
Iraq	Mr. A. Eastwood.
,, ...	Mr. E. Guest.
Kenya Colony	Mr. S. Gillett.
,, ,, ...	Mr. C. B. C. Handley.
,, ,, ...	Mr. A. Holm, C.B.E.
,, ,, ...	Mr. C. L. Silvester.
Nigeria	Mr. W. G. Beattie.
,, ...	Mr. O. F. Faulkner.
,, ...	Mr. A. V. Gibberd.
,, ...	Mr. J. L. B. Kincaird.
,, ...	Mr. P. W. T. Leigh Boughton.
,, ...	Mr. H. Roebuck.
,, ...	Mr. E. H. G. Smith.
,, ...	Mr. E. A. Trotman.
,, ...	Mr. R. Turner.
Sierra Leone	Mr. E. Hargreaves.
,, ,, ...	Mr. P. J. Moss.
Sudan	Mr. R. E. Massey.
Tanganyika	Mr. J. E. Bruce.
,, ...	Mr. P. J. Greenway.
,, ...	Mr. T. W. Kirkpatrick.
,, ...	Mr. G. Milne.
,, ...	Mr. F. J. Nutman.
,, ...	Mr. J. F. C. O'Brien.
,, ...	Mr. F. M. Rogers.
,, ...	Mr. A. H. Savile.
,, ...	Mr. C. Smee.
,, ...	Mr. C. M. H. Sutherland.
Uganda	Mr. L. Hewitt.
,, ...	Mr. H. R. Hosking.
,, ...	Dr. J. D. Tothill.
,, ...	Mr. J. M. Wallace.
,, ...	Mr. N. J. Williams.
West Indies	Mr. F. G. Harcourt.
,, ,, ...	Mr. M. D. Lumsden.
,, ,, ...	Mr. K. T. Rae.
,, ,, ...	Mr. F. Stell.

The following officers of the Corporation's staff abroad are on leave in this country:

Nigeria	Mr. G. Browne.
Nyasaland	Mr. H. C. Ducker.
South Africa	Mr. F. R. Parnell.
,, ,, ...	Mr. G. C. Ullyett.
Trinidad	Dr. S. C. Harland.

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THE INVOCATION OF NATURAL SELECTION

SOME considerable time has passed since last the world was faced by a problem as complex and as difficult of solution as that which at present confronts it; and the way in which the problem is left to solve itself (when quite possibly the solution thus reached may be very unpalatable) is not altogether to man's credit. Barely five years ago (*cf.* this journal, Vol. IV., 1927, p. 1) we had a year of considerable over-production in cotton. The growers, aided by an unusual combination of favourable natural and other circumstances, carried out their proper function—the production of the maximum quantity possible, with the least possible cost in labour and other expenditure—with perhaps the most complete success on record. For this enormous production of wealth* for mankind they should have found some reward, even if it were but a small one. In actual fact they had to pay dearly for their success, on account of the low prices that they obtained for the unusually large crop, and this although cotton is a product that is capable of spending a considerable time in storage without appreciable deterioration, and that need not be consumed at once, like many things must be. This result, as we pointed out at the time, was a bitter satire upon present methods of production and distribution.

In that instance, however, only one of the great products of world-wide production and use was affected, while at the same time it was an annual crop, so that in the following year the excess was largely compensated by a diminution of production—a rough-and-ready method, which is not quite so applicable to a perennial crop like rubber, for example. The trouble was but temporary, and to a great extent the horizon became clear once more with the passing away of the clouds of depression that for a period had hung over it.

At the present time, however, not only cotton, but almost everything, be it raw material (the product of cultivation or of mining)

* £450,000,000 at £15 a bale.

or finished articles (the products of manufacture), seems to be turned out in excess of the demand. The satire upon our methods is in fact more cruel than ever. Endless discussion goes on, dealing with this phenomenon and its causes, and with proposals for removing or mitigating the universal depression to which it has given rise, but little or nothing is done, for people cannot agree about it. Is the real cause over-production, or is it under-consumption? Is it both, or is it neither, or are both these phenomena merely symptoms of some more deeply underlying cause that is operative? Must we work to reduce production or to increase consumption, or both, or is this merely applying salve to a sore place without removing the real underlying cause, so that sooner or later it will break out again, as in fact these periods of deep depression have so often broken out? And so on.

There is one rather noteworthy fact about the present situation which indicates that while, so to speak, rations are reduced, there is little or no sign that this reduction, in itself, is doing anyone any particular harm. In other words, under present conditions, prosperity would appear to have a distinct dependence upon waste. The more of any given thing that people use, the more prosperous on the whole will be the industry of growing or making that particular thing, but only up to a certain point, for its prosperity rests upon a very insecure basis. It will inevitably attract new people to desert other occupations in order to take up the one under consideration, and there will be the familiar "boom," followed by the equally familiar "slump." Very often, though far from always, it will be the comparative newcomers, with their smaller experience and technical skill, who will be liable to be the first to go to the wall when the more intense struggle comes, though there may be many exceptions in the case of those who have brought with them unusual ability or much capital. Sooner or later, production will overtake consumption, though that time may be put off by the increase of the latter due not only to increasing population and increasing use, but to the continual discovery of new applications, to increasing wastefulness on the part of users, to deterioration of quality on the part of the producers, and to various other causes.

With the continual improvement that is going on in the methods of cultivation and of manufacture, in mass-production, in standardization, and in everything concerned with growing or making anything, the total output of material, especially, perhaps, of manufactured goods, tends continually to increase, and probably on the whole to increase more rapidly than the demand. Especially is this the

case with material that can only be used as food, for there is no such very rapid increase of population going on, while at the same time people are gradually learning to eat less food.

If, as was the case in 1926-27, only one of the great world-products (on that occasion cotton) suffer from over-production, then while its producers may incur great losses, and (owing to their diminished purchasing power) these losses will react to some extent upon producers of other articles, still the reaction gradually dies out among the crowd. But supposing that several are over-produced at the same time, the case may be very different, and the effect may be so to reduce the power of purchasing other things (which in themselves may not be really over-produced) that in a very short time everything may come into the position in which practically all industries find themselves at the present time, of over-production and under-consumption. It is a simple case of the "vicious circle," and if one could reverse the operation, one might be able to return fairly quickly to a more normal condition of things; but this is more easily said than done.

When the question is asked, however, as to what it is best to do to bring about a more normal state of affairs, opinions differ widely—so widely, in fact, that nothing seems even to be attempted. The most favoured view in many quarters, and the one which is in actual fact being allowed to operate without interference, is simply *laissez-faire*. The underlying idea is that a simple operation of the law of the natural selection of the fittest, with their consequent survival, will in time do all that is required. True it is that, given time enough, things will adjust themselves, but this will not be in any way whatever a real survival of the fittest, for natural selection in this case has been so much interfered with by man's operations, has become so complicated, and so involved in totally extraneous considerations, that one can no longer rely upon it (or rather, upon what passes for it in the ideas of this school) really to pick out the fittest as survivors.

The general idea which this school has in view is somewhat as follows: let all the producers do their utmost till the fall in prices drives to the wall those whose cost of production is the highest, who are least efficient, who have least capital behind them in the event of a run of bad times; and so on. Now there is no doubt that competition like this has much to be said in its favour, in that its tendency is to drive everyone to be as efficient as he knows how, and to ensure the rapid adoption of all those improvements that scientific investigations have shown to be possible without costing too much to be worth while. But in recent times people are begin-

ning, and with justice, to ask the question whether, in the homely phrase, the game is worth the candle, or whether the same desirable results in progress and improvement could not be attained in a less wasteful manner.

To allow a cut-throat competition, and to allow "natural selection" to choose the survivors, is a solution which is normal enough so long as the conditions remain fairly like those under which the battles of real natural selection are fought out—the competitors being close together, or not separated by great distances, having nothing to do with any far-away species or kind of animal or plant, and all living *under approximately equal conditions.* In such circumstances natural selection will pick out as survivors those that are most efficient under the conditions that prevail at the time. And as in a state of nature conditions only change with extreme slowness, the survivors that are picked out, and their offspring, will have a long run before any other kind of survivor begins to cut them out in turn. The inhabitants of one village or small district, in the days when markets were strictly local (*cf.* article on p. 173 in this volume), would be in conditions of this kind, and victory in the struggle would be to him who was most skilful, most efficient, most ready to improve his methods, and so on. But with the passing of this "localism," and with the vast improvements in methods of transport, which have made of so many formerly local things products which have a world-wide cultivation and a world-wide market with world-wide prices, there passes away also to a very large extent the strict application of natural selection. An individual cultivator may be at the very top of the tree in all that relates to his business—he may be skilled, efficient, businesslike, and intelligent to the very highest degree—and yet he may be driven to the wall by conditions that are absolutely beyond his control in any way whatever, and with which he has had nothing whatever to do. He is completely at the mercy of the manœuvres of governments with tariffs, with provision of proper means of transport, and of numerous other things and conditions which affect not only himself but all his neighbours alike. To talk of natural selection as picking out the best to survive, in these days of world-wide-ness, of the consequent enormous variation in the natural conditions (and even of many all-important artificial ones, such as transport), and of the manœuvres of the many and distinct governments under which the cultivators have to work, is to stretch the idea completely beyond its proper application.

The conditions which affect the individual cultivator, in whatever part of the world he may find himself, are now so all-embracing that

it would appear not improbable that the time for individual competition is approaching its end, and that some form of co-operation which may form larger units (whether competitive or not) is indicated as perhaps the next stage that will be reached. The present situation, in which the most skilful, efficient, and meritorious individual (or even company) may suddenly find the dice so loaded against him through no action of his own that he cannot hope for success, is not without its element of pathos. It is time that we ceased to invoke the idea of natural selection.

A SHORT ACCOUNT OF THE HISTORY AND DEVELOPMENT OF COTTON IN UGANDA

BY

G. W. NYE.

THE object of this paper is to place on record a short account of the development of cotton as an industry in Uganda. Information is scanty and difficult to obtain, and the writer would be grateful to any reader sending further information that may be available.

The actual origin of cotton in Uganda is shrouded in the mists of antiquity, and it is very difficult to find any reference to wild or indigenous cotton plants except in one or two isolated cases. In 1862 Speke and Grant reported that *G. barbadense* was to be found in Uganda, but no mention is made as to whether the plants grew wild or were cultivated. In 1872 Samuel Baker, coming from Egypt by the Nile, brought with him some seed of "Gallini" cotton which he established near Masindi in Bunyoro. In 1880 Emin Pasha, writing of the Equatorial Province (which included part of Bunyoro, all Gulu, and what is now the West Nile district), stated: "A kind of cotton also occurs in some localities; for instance, in the country of the Bari a Gossypium is found, the ripe grains of which are green, but the cotton has long and fine fibres. Some Danagla living here, and who are skilled in weaving, made a loom, and now many people are earning their bread by making so-called damur, a home-made cotton material which is very well suited for our climate." In 1886 he writes from Wadelai:* "I send you a sample of the beautiful pocket-handkerchiefs we have made from cotton that we planted and spun ourselves." In 1893 Lugard reports "a wild cotton grows throughout Uganda." Apart from these few references no further information is available, and that obtained from natives is equally vague. So-called wild cottons were reported in the early stages of the cotton industry from nearly every district, but it is doubtful whether any of them were really indigenous. Certainly no native spinning industry has existed except in one or two cases in a small way—the existence of barkcloth rendered it unnecessary to find any other plant for making clothes.

* Wadelai, south of Rhino Camp, north of Pakwach, on east bank of Nile.

So-called "Wild" Cottons.—There is a cotton in Buganda called by the natives Segamwenge, which means that a man could not pass it when under the influence of liquor. Specimens of this have been obtained and were grown at Bukalasa last season. It is a tree cotton of the *Gossypium brasiliense* type, but it did not grow very well at Bukalasa, as it became heavily infected with blackarm. The natives, generally, know of this cotton, but very few appear to have seen it before, and no information can be obtained as to whether it was ever used by them. Reports state that Arabs used it in King Mutesa's time for making pillows. It seems very unlikely that this cotton is really indigenous, and it is probable that it was introduced by Arabs or other traders from Egypt or the Sudan, and may, in fact, be similar to the "Jumel" cotton in Egypt and the Nyam-Nyam cotton in the Sudan. The *G. barbadense* reported by Speke and Grant was undoubtedly this variety.

In Busoga there is a "wild" cotton called by the natives "Bufumese." No specimens are available, but from all accounts it is similar to Segamwenge, and has been used in a small way for making caps, belts and socks.

In 1910 Mr. Lamb, Director of Agriculture, while on a safari in Lango, reported having come across specimens of *G. obtusifolium* var. Africana and *G. brasiliense* on the northern shores of Lake Kwania. He stated that the former had been cultivated since ancient times, but had then been replaced by Brasiliense on account of its superior staple. The natives said that Brasiliense had been introduced into Lango and Buruli within living memory, probably from Bunyoro, and the Lango women used the cotton for making their frontal frills, the plants being grown as one or two shrubs outside the houses.

The Gallini cotton introduced by Baker, together with cotton reputed to have been introduced by the Arabs many years previously (probably Segamwenge), was used in Chua for spinning, the process being to gin the cotton by hand and then to place the lint in a calabash at the bottom of which there was a small hole; through this hole the cotton was drawn out and rubbed against the thigh with the fingers, making a sort of thread. The thread produced was knitted into small hats with needles made from bamboo.

In addition to the above there is also a "wild" cotton reported from the Western Province, called "Ewaru," which seems to have been introduced by the Sudanese in Kabarega's time.

Cotton as a Commercial Crop.—Prior to 1903, apart from small trials made by the missions, no use of cotton as an economic

crop appears to have been made, and such cottons as were existent in the country were obviously unsuited for export. In 1903 the Government imported from Egypt ½ ton of seed of each of the following varieties: Abassi, Afifi, and Ashmouni, and this seed was distributed to natives in accessible parts of the country for trial in April and May, 1904. At the same time the Uganda Company imported ½ ton of the following types: American Upland, Afifi, Peruvian Sea Island, Black Peruvian, and Yannovitch. Seed of this was distributed in the following countries: Bulemezi, Buruli, Kyadondo, Singo, Gomba, Kyagwe, Busiro, and Bwekuli. Of these Uganda Company importations only American Upland (var. unknown) was successful, all the others being a complete failure. By this time considerable interest in cotton was evinced by the natives, and this led the Government to import an extra ton of each of the three Egyptian varieties mentioned above. These arrived late in 1904, and in the following season were distributed to interested natives in Buganda, Bunyoro, and Busoga. Ashmouni and Afifi were complete failures, but Abassi showed considerable promise.

The results of the Uganda Company's trials with American Upland were so promising that the Government obtained through the British Cotton Growing Association a ton of American Black Rattler seed, which was distributed to growers in Buganda, Bunyoro, Busoga, and Ankole in 1905. At the same time, owing to the fact that Abassi was the more valuable cotton, further trial with this cotton was considered advisable, and 5 tons were accordingly imported in August, 1905, but owing to the success of Black Rattler only 1¼ tons of Abassi were distributed.

The next importation took place in December, 1905, when, strangely enough, more Abassi was imported, "owing to certain representations made in favour of this variety." The seed was grown in a small plot at Entebbe, but proved a complete failure. The result of this last failure of Abassi was a definite decision that American Upland varieties were the only ones likely to produce an economic crop. Following this decision a further ton of American Upland (var. unknown) was imported in April, 1907.

In addition to distribution by the Government, a considerable amount of seed was distributed by the Uganda Company at the same time. The result of this must have been an enormous mixture of varieties, the descendants of which are probably still in existence in Buganda. During this period all the seed was picked over by hand before distribution, with the object of removing all naked seed and thereby getting rid of the Egyptian varieties.

Prior to 1907 the Uganda Company was the sole buyer in the Protectorate, but in 1907 buying was still uncontrolled, and the crop being attractive, a number of native and Indian buyers entered the field and there was great competition for the crop, cotton of any sort being readily purchased. The price that year was Rs. 6 to 8 per 100 lb. There were, of course, no fixed buying posts at that time, and the buyers wandered from plot to plot setting up their scales on the plot itself and buying anything that was offered to them; the consequence was that a very high percentage of the crop was picked before it was mature, and no attempt was made to separate the cotton out into various grades. Several cases occurred at this time of growers picking the bolls green and drying them in the sun outside their houses until they opened, and it was not surprising, therefore, that even at this early stage serious complaints were received from home as to the quality of the crop.

A conference of those interested in the formation of a sound cotton industry was called by the Government in 1907. It was then decided that only American Upland seed should be imported, and that owing to the grave danger of an admixture of numerous varieties some control in the distribution of seed was necessary. Measures were taken to eradicate all undesirable types and to supply only one variety, the seed to be obtained from numerous Government seed farms established at various centres.

In 1908, 35 tons of Black Rattler seed were distributed, and only between 5 and 10 per cent. of the plants were other than Upland. Special planting instructions were issued by the Government, the main points being, spacing between the rows from 3 to 5 ft. and between the plants from 1½ to 2½ ft., and four seeds to be sown per hole, the holes being dug a week previous to sowing. The instructions also stated that seed should be soaked in water twelve hours previous to planting, and that the plants should be hilled when 6 to 8 inches high and again when 16 inches high.

The only ginnery in existence at this time was one belonging to the Uganda Company in Kampala. This meant that considerable distances had to be travelled with head loads, and in order to relieve the native of some of the burden of these loads the Government constructed in Entebbe a number of small wooden hand gins similar to the Churka gin used in India at the present time. These were sold at Rs. 15 each, but they apparently proved unsatisfactory—probably owing to the extraordinarily uneven lint that must have been produced, and were all withdrawn and the owners compensated.

By 1908 the crop had spread considerably in Buganda and Busoga. Even at this time reports comparing Kampala and Busoga cottons showed the latter to be more soft and wasty than the former and to be worth ¼d. per lb. less.

By this time also several seed farms were in existence, including one run by the Kangao at Bowa to supply seed in that area.

In 1909 82 tons of seed were distributed, consisting of Black Rattler and "Ordinary Uganda" seed. This was all picked over by hand before distribution, the naked seeds being rejected. At this stage only 1 per cent. of the crop showed Egyptian characters.

During the year several new varieties were tried, and the following yields were obtained at a Government seed farm at Namenge in Busoga.

	Lbs. per Acre.
Local cotton (probably Black Rattler)	555
"Naked-Seeded Uganda"	66
Sunflower	516
Allen	258
Griffen	320
Abassi	Complete failure

It is a curious fact that, despite the Government decision to grow Upland Cotton only, Abassi was still being tried, and in the 1910-11 season quite a fair acreage was planted up with this variety at Bululu in Lango, but this is the last time that it appears. Other than this Abassi, only Sunflower and Allen existed, as well as a small acreage still under Black Rattler in Buganda. The distribution of the crop at this stage of development is interesting. In the 1910-11 season the acreage figures were as follows:

	Acres.
Buganda	21,818
Busoga	8,828
Kumi	4,500
Mbale	1,071
Lango	574
Bunyoro	1,988
Ankole and Toro	2,914

In June, 1910, a small plot of Caravonica was planted at Nimule; it yielded at the rate of 560 lb. per acre, and gave cotton with a staple of 1⅜ inches. No further trial appears to have been made with this variety.

It is interesting to note that in 1910 the average size of a cotton plot was 25 yards by 14 yards, which was reported as being nearly eight times the size of those of the previous year.

In the 1911-12 season the first true cotton experiment station was opened at Kadunguru, where work proceeded for a few years

until 1916, when Simsa near Soroti (Teso) was chosen as being a better site. The yields per acre in Teso for that season were as follow:

	Lbs. per Acre.
Kumi	480
Soroti	310
Usuku	256
Serere	617

In 1911 Sunflower seed was obtained from East Africa, where it had been grown in the previous season. This was sown together with all the available seed of Allen in segregated areas in Bukedi. Both varieties had high yields, and samples sent home for broker's report gave 350 points on for Allen and 250 for Sunflower. From this season onwards to the present time a spacing of 4 by 1½ ft. was advocated, with planting not later than July, in the Eastern Province.

By the 1913-14 season the acreage in the Eastern Province had reached over 83,000, while that in Buganda had remained almost stationary at 25,000 acres. This season the whole of the Eastern Province was under Allen except for a segregated area of 6,000 acres in Teso planted with the new Sunflower. In the following season it was decided to replace Allen with Sunflower, and in 1916-17 for the first time the whole Protectorate was planted with seed derived from a local selection—in this case a selection from Sunflower grown at Kadunguru. During this period the spread of the industry was affected by war conditions and the consequent shortage of staff—that the war effect was not greater than it was reflects great credit on the labours of the few who were left behind to carry on.

In 1915-16 the first Nyasaland Upland cotton was imported and grown at Kadunguru. The origin of this variety is stated to be as follows: "The Nyasaland cotton supplied to Uganda in 1915 was obtained by a line selection from a mixed crop of long-stapled Uplands in which the variety 'Floradora' predominated. The bulk crops from which the selection was made had undoubtedly had an opportunity of being contaminated with Sunflower, Griffen, and other varieties. . . ."

The year 1918-19 saw the industry established on a sound footing with an acreage of 145,000 acres and forty-two ginneries in operation. This season was a definite landmark, as new cotton rules were issued providing for a system of licensed buying posts with continuous buying, instead of the markets with fixed buying days which were previously in existence. During this season also for the first time a cotton tax was imposed of 4 rupee cents per lb. of lint on all cotton produced from seed sown in 1918. The money obtained from this

tax was definitely to be earmarked for the development of the cotton industry, including the opening and maintenance of two cotton selection stations, one for Buganda Province and one for the Eastern Province—*i.e.*, at Bukalasa and Serere. Cotton selection work began at Serere as soon as the buildings were erected and the land cleared, but, although the plantation at Bukalasa has been established since 1922, no change of seed has been made in Buganda since 1916, when Sunflower was distributed. Even then the older types were not completely eradicated, with the consequence that to-day the Buganda crop consists of an amazing mixture of plant types actually varying from completely red plants to plants devoid of any red pigment or variegated, from plants giving practically no lint per seed to those with a ginning outturn of nearly 40 per cent., and so on. The result of this, however, is that a wonderful field for selection purposes is available, and although it will undoubtedly take a considerable time to fix any desirable type, there is no doubt that it will be possible to improve on the yield and uniformity of the existing mixture.

The season 1919-20 saw a great rise in prices as an aftermath of war, actual sales taking place in Liverpool at 59·15d. per lb. The consequence of this was that the growers became enriched in the space of a season, and the crop became very attractive as a means of purchasing clothes, bicycles, and so forth. Next season produced an increase of 50,000 acres, but unfortunately the pendulum of prices swung in the opposite direction, the Government price in the Eastern Province being 3 florins per 100 lb. Even at these low prices buyers would not, or could not, buy, with the result that to avoid loss of the crop the Government had to buy in certain areas. The total purchase by the Government only amounted to just under 4,000 bales, but this intervention had the effect of giving confidence to the growers.

The low prices of the 1920-21 season were reflected in the acreage of the 1921-22 season, which dropped to the 1919-20 level. After this setback, however, the acreage increased rapidly, reaching practically 700,000 acres in 1928-29.

In the meantime the Serere Experiment Station was being developed and work done on the selection of suitable strains for the Eastern Province. The Nyasaland variety was worked on almost to the exclusion of other types. A selection, N.32, made in the original plot of Nyasaland in 1915-16 was a promising strain, and was worked up gradually, until in 1921 it was planted in the Kadunguru gombolola and distributed throughout Teso and Lango in the following year.

In 1919 N.30, a brother of N.32, was grown at Simsa, and in this plot a selection, N.17, was made. A 3-acre plot of N.17 was grown in 1922 at Serere, and this stood out as being resistant to a disease which was undoubtedly blackarm. N.17 formed the main crop at Serere and Simsa in 1924-25, and in the following season it was grown in the Kadunguru gombolola, which is suited to segregation, and from this stage it has gradually been increased until it has now been distributed over the whole Eastern Province. In most areas it has given better results than the pre-existing type, which was mainly N.32. A new strain, S.G.29—also a selection from Nyasaland Upland—is now being used to replace N.17.

TABLE I.—SHOWING THE INCREASE IN THE COTTON CROP SINCE 1906.*

Year.	*Acreage.*	*Bales.*	*Calculated Yield per Acre.*	*No. of Ginneries.*
1906	—	500	—	—
1907	—	2,000	—	—
1908	—	4,000	—	—
1909	—	5,000	—	—
1910	—	12,000	—	—
1911	—	20,000	—	—
1912-13 ..	50,000	26,000	690	—
1913-14 ..	110,000	40,000	480	—
1914-15 ..	118,000	26,000	290	—
1915-16 ..	92,000	22,000	320	—
1916-17 ..	129,000	28,000	290	—
1917-18 ..	134,000	27,000	270	—
1918-19 ..	145,000	36,000	330	42
1919-20 ..	155,000	47,000	400	58
1920-21 ..	207,000	81,000	520	—
1921-22 ..	164,000	48,000	390	100
1922-23 ..	345,000	88,000	340	101
1923-24 ..	418,000	128,000	410	—
1924-25 ..	572,000	196,000	460	147
1925-26 ..	610,000	180,000	390	—
1926-27 ..	590,000	131,000	290	176
1927-28 ..	533,000	138,000	350	189
1928-29 ..	698,000	204,000	390	192
1929-30 ..	663,000	129,000	250	192
1930-31 ..	724,000	Incomplete	..	..

* The acreage figures are inaccurate, but they suffice to give some idea of the rapid spread of the crop.

TABLE II.—SUMMARY OF MAIN EVENTS CONNECTED WITH COTTON IN UGANDA.

1872	Gallini cotton introduced by Samuel Baker into Bunyoro.
1903	First Government importation of seed for trial. Uganda Company also imported seed.
1905	Variety Black Rattler grown with considerable success.
1907	Decision to proceed with American Upland types only.
1908	Government took full control of importation and distribution of seed.
1911	First proper seed station opened at Kadunguru; Sunflower obtained from East Africa.
1913-14	Acreage over 100,000.
1915-16	First importation of Nyasaland Upland.
1916-17	First time whole Protectorate planted with a selection made locally.
1918-19	Introduction of cotton tax.
1919-20	Prices up to 59d. per lb. paid. Serere Experimental Station opened.
1920-21	Drop in prices—Government purchased part of crop.
1925-26	Strain N.17 first put into general distribution.
1928-29	Bales attained 200,000 mark.
1929-30	Serious spread of blackarm disease.

REFERENCES.

The following books and papers have been referred to:

"A Journey to the Source of the Nile." Speke and Grant.
"The Rise of Our East African Empire." Lugard.
"The Wild and Cultivated Cotton Plants of the World." Watt.
"Emin Pasha in Central Africa." Schweinfurth.
"A Review of the Work of Cotton-Seed Selection in Uganda, Years 1911-1925." Harper, *E.C.G. Review*, vol. iii., No. 1.
"Annual Reports, Department of Agriculture, Uganda."

Received July, 1931.

RAINFALL AND COTTON YIELDS IN THE GEZIRA

BY

R. HEWISON.

COTTON has been grown in the Gezira as an irrigated crop since 1911, when its cultivation was started on an experimental scale at Tayiba; experience of twenty completed seasons is therefore now available. In the earlier years Mit Affifi was the main variety cultivated, though small areas of various other kinds were also grown. As the cultivated area extended first Nubari and then Sakellarides supplanted Mit Affifi, until by the time the big extensions were undertaken the crop was practically all Sakel.

From 1911 to 1914 cultivation was confined to the Tayiba area of some 670 feddans of cotton. In 1914 Barakat was started and the cotton area was increased to 3,000 feddans. Only comparatively small additions to the area were possible until after the war, but in 1921 the Hag Abdalla Pumping Scheme commenced working and the area under cotton rose to 9,800 feddans. In 1923 the installation of the Wad el Nau Pumps allowed of a further increase of about 10,000 feddans. In 1925 the Sennar Dam came into operation and the area of cotton went up to 80,000 feddans. Extensions continued in the succeeding years, until in the 1930-31 season the total area of cotton cultivation in the Gezira amounted to 196,023 feddans.

Up till the 1928-29 season the yields, while varying considerably from year to year, had maintained a very satisfactory all-over average. Including that season, the average yield for all the seasons was 3·93 kantars of seed cotton per feddan. The range had varied from 5·62 kantars in 1912-13, on an area of 250 feddans, to 2·12 in 1924-25, when the area was 21,616 feddans. In the 1929-30 season, however, the average yield for the whole irrigated area dropped to 2·33 kantars, while in the 1930-31 season it was 1·35 kantars only. Such a big drop in the average yields, coinciding as it did with the heavy fall in cotton prices, created a situation of considerable difficulty and uncertainty for those responsible for the operation of the Gezira Irrigation Scheme.

The 1929-30 season had the heaviest total rainfall recorded since irrigation was started in the Gezira, while 1930-31 had a rainfall about 10 per cent. above the average for a twenty-year period. In both seasons Blackarm attack was very severe throughout the crop. In addition, Leaf Crinkle, an insect-borne virus disease, caused considerable damage to the 1929-30 crop, and was very much worse in 1930-31. The partial failure of the crop in these seasons could be largely attributed to the effects of the Blackarm and Leaf Crinkle infections, and every measure that scientific research and practical observation could suggest as likely to control these two diseases was considered, and as far as possible adopted, with a view to preventing a recurrence of a similar disaster to the next and succeeding crops.

The fluctuation in the annual yields had been in the main ascribed to variations in the climatic conditions in different seasons. Certain insect pests and plant diseases, particularly Blackarm, were known to be responsible for reductions in yield, varying in degree in different sections of the area, and from season to season. A connection was known to exist between climatic conditions, particularly the amount and distribution of the annual rains, and the extent and severity of Blackarm infection in any particular season. No attempt had been made, however, to obtain a value of the connection between particular climatic conditions and the yields so far obtained. In view of the position, therefore, it was decided to investigate the data available in an attempt to ascertain what factors, if any, had exercised a controlling effect upon returns in the past, and to estimate in the light of such information as the records provided, and knowledge and experience could interpret, the extent to which such factors might be expected to apply in the future.

With this object in view a study has been made of the records kept in connection with the original Tayiba area, on which cotton growing under irrigation was started in the Gezira. These particular records were chosen for the following reasons:

1. They cover a longer period than any similar records which are applicable—*i.e.*, twenty years.

2. While the total area is considerable, some 5,000 feddans gross, it lies in a compact block, and in such a position relative to the point at which the meteorological records have been taken that these may be regarded as a fair reflection of the conditions prevailing throughout.

3. No new land—*i.e.*, land previously unirrigated—has been taken in since the 1916-17 season. The whole area, therefore, has been under irrigation for at least fifteen years, and has borne a minimum of five cotton crops, with lubia, and later, dura, in proportion.

4. In the first few years some of the Tayiba area was subjected to more intensive cropping and irrigation than is now practised. Any influence, therefore, which continuous irrigation and cropping might exert on the fertility of the soil may be expected to be more definitely reflected in the yields than would be the case on an area where the ordinary rotation had been followed.

Of the various factors examined, the effect of the rainfall upon the annual yields has been found to be the most definite and the most consistent. The present note, therefore, is confined to a consideration of this particular factor.

The rains in the Gezira occur during the summer months. Occasionally slight falls are recorded as early as April and as late as November. In rather more than half the seasons recorded rains have occurred in May and in October, but the falls have usually been light. In sixteen seasons out of twenty rain has been recorded in June, and in some years the amount has been considerable. In every year rains occur in July, August and September.

For the twenty years recorded at Tayiba the average annual rainfall works out at 378·5 millimetres. During this period the percentage of the total precipitation occurring in the various months was as follows:

	Per Cent.
May	3·90 including slight falls in April.
June	9·95
July	32·10
August	38·20
September ..	14·65
October ..	1·20 including slight falls in November.

Most of the rainfall occurs as heavy showers generally very local in character, a "wet day" over a large area being very uncommon. Falls of over 100 millimetres have been recorded, while 50 to 80 millimetres are not uncommon.

From the data obtained a series of graphs have been prepared which bring out the main points of interest and importance. The data from which these graphs have been compiled have been subjected to statistical investigation on the lines now considered to be essential in connection with the interpretation of any experimental results, and the correlation established has been found to be definitely significant. In fact, the degree of correlation shown to exist between rainfall and yields is nearly double that which is necessary for definite deductions to be made.

Graph No. 1 shows the range of the annual average yields of cotton per feddan in the " Old Tayiba " area for nineteen seasons. (The average yield for the twentieth season has not yet been worked out.) Inverted above the yield line is shown the total annual rainfalls registered at this station for the twenty seasons 1911-30.

Graph No. 2 shows the total annual rainfalls as recorded at Wad Medani, above 12 kilometres away, for a period of twenty-nine years, 1902-1930. For comparison the Tayiba rainfall as shown in No. 1 is also included. The average annual rainfall for twenty-nine years at Wad Medani is 396 millimetres, while for twenty years at Tayiba it works out at 378·5 millimetres.

Graph No. 3 shows (1) the average Tayiba rainfall for five-year periods, and (2) the average yields of cotton for the same five-year periods.

Graph No. 4 shows the averages at Wad Medani for the same five-year periods, and in addition that for the nine years preceding the commencement of Tayiba, and for the twenty-nine years 1902-30.

Graph No. 5 shows the departures from the average in respect of rainfall and yield at Tayiba for each of the twenty seasons.

Graph No. 6 shows the average yield for twelve seasons in which rainfall was under average, and for seven seasons in which it was over average.

(NOTE.—For the purpose of this discussion the terms " dry " or " wet," as applied to any particular season, are intended to mean that the rainfall for that year was respectively under, or over, the average for the whole period under review.)

In connection with these graphs, certain features of interest are noticeable:—

Graph No. 1 indicates a steady increase in the average rainfalls at Tayiba during the twenty-year period. This is most clearly demonstrated in Graph No. 3. The heaviest increase is in the third period, when the average for five years was 431·4 millimetres. This does not support the opinion sometimes expressed, that the increase of irrigation in the Gezira has been responsible for an increase in the annual rainfall.

In spite of the fact that the average for the final period, 1926-30, is swollen by the figure for 1929—the second heaviest rainfall recorded for twenty-nine years—the increase for this period, during which the Irrigation Scheme has been gradually extending, is less than during

the previous five years, 1921-1925, when a much smaller area was under irrigation. Examination of the Wad Medani records, moreover, shows that Tayiba was started at the commencement of a cycle of low rain years, and that at Tayiba the dry condition was definitely more marked than at Wad Medani.

Graph No. 4 shows that for the period of nine years preceding the starting of Tayiba the average recorded at Wad Medani was 405·1 millimetres, which is almost exactly the same as that for the same station for the last period, 1926-1930. This graph, moreover, does not support the conclusion which could be drawn from the Tayiba records, that a steady increase in the rainfall had been in progress for some twenty years. It does corroborate, however, that there have been alternate periods of wet and dry years, of various durations, and would appear to indicate that such cycles are to be expected. At Tayiba there have been certain definite periods of dry and wet conditions. The dry periods were: 1911, 1912, 1913, 1914; 1916, 1917, 1918, 1919; 1924, 1925, 1926, while 1928 is also classed as a dry year.

The wet periods were: 1920, 1921, 1922, 1923; 1929, 1930. Other wet years were 1915 and 1927.

Graph No. 1 shows that a general correlation between rainfall and yields definitely exists, and in *Graph No.* 5 this is even more clearly brought out. A study of this latter graph will show that for nineteen seasons, with three exceptions, under average rainfall was connected with over average yields, while over average rainfalls were succeeded by under average yields. The three exceptions were:

1916–17	*under*	average rains,	*under*	average	yields.
1922–23	*over*	,, ,,	*over*	,,	,,
1924–25	*under*	,, ,,	*under*	,,	,,

Examination of the records for these three seasons brings out some interesting points, and provides some explanation for the apparent discrepancies.

1916–17: *Rainfall* 297·9 *millimetres ; yield* 3·47 *kantars.*

This yield was only 3·7 per cent. below the average. It is noticeable, moreover, that there is a greater difference between the rainfalls recorded at Tayiba and at Wad Medani in this year than in any other in the series. Wad Medani records show a total of 507·2 millimetres against Tayiba's 297·7 millimetres. While there is a general similarity between the records in most seasons, there is not an absolute

agreement. It will be noted that while for the ten years 1911-1920 Tayiba was generally drier than Wad Medani, during the next ten years more rain fell at the latter station on all but three occasions. It may be, therefore, that in 1916, although the actual precipitation registered at Tayiba was less than average, the general conditions were those of a wet season, as they undoubtedly were at Wad Medani, and throughout the irrigated area.

1922-23: *Rainfall* 529 *millimetres ; yield* 4·43 *kantars.*

Of the total rainfall for this season 295 millimetres fell between July 5th and 22nd, 108 millimetres on one day, the 22nd. All cotton sown before this date was completely washed out. A total re-sow of the whole area was possible, however, by the end of the month, while the conditions during August and September were normal and for the rest of the season distinctly favourable.

1924-25: *Rainfall* 315 *millimetres ; yield* 2·34 *kantars.*

Of this total rainfall 210·8 millimetres, or two-thirds, fell between July 31st and August 13th—*i.e.*, at the most critical period of all. This was a bad season throughout the Gezira.

Graph No. 6 shows the average yield obtained in twelve dry seasons as compared with the average obtained in seven wet years. The difference, which amounts to 1·35 kantars per feddan, would have been greater but for the abnormal results of the season 1922-23 referred to above, when an over average rainfall was followed by an over average yield.

The following conclusions are presented:

1. Examination of these records reveals a definite connection between the annual rainfall and the average yields of cotton for the period under review.

2. In seasons of light rainfall the average yields have tended to be high—*i.e.*, above the average—while in years of heavy rains they have been depressed.

3. It is probable that in dry seasons the influence is negative, and that in wet years it is positive.

4. The influence of the rains upon the cotton crop is both direct and indirect.

5. When the rains, which in the Gezira occur at or about the sowing season, are heavy they affect the development of the young plants adversely by producing conditions unfavourable to growth. Even when the seedling plants are not destroyed by actual flooding,

the physical condition of the soil is affected by heavy and continuous rains. Excess of moisture in the upper layers of the soil interferes with early root development, and the lack of aeration in a soaked, puddled soil produces conditions definitely unfavourable to the growth of the young cotton plants. The weeds, which develop rapidly with heavy rains, compete with the young cotton plants for the available plant food in the soil, and being better adapted to the conditions are likely to succeed at the expense of the cotton plants.

6. Heavy rains, particularly during the month of August, prevent sowing at the best time, with the result that a proportion of the crop is late sown. Late sowing in the Gezira definitely causes a reduction in yield.

7. Heavy rains affect the young cotton by producing conditions favourable to the development of certain pests and plant diseases. The spread of Blackarm is definitely associated with rain, and the development of this disease in the plant appears to be largely regulated by the amount of moisture in the atmosphere and in the soil.

8. Less is known of the influence of rains upon Leaf Crinkle, which in the last two seasons has been a very serious factor in reducing the yields. Since, however, ratoon growth from the previous season's cotton roots is the chief source of infection of the new crop, and early rains, which are generally correlated with a wet season, tend to increase the amount of such growth, it is reasonable to suppose that a connection exists between the nature of the annual rains and at any rate the first infection of the seedling cotton. In addition, early rains may cause an increase in the number of "White flies" at a time when cotton growing is most susceptible to the infection, of which they are the only known carriers on the Gezira.

9. It is probable, moreover, that the rains, and particularly early or very heavy falls, exercise some indirect and uncertain influence on the crop by affecting the micro-organisms of the soil, and through them the supply of available plant food.

10. On these records the ratio of dry to wet years is nearly 2 : 1. At Tayiba it is 12 : 7, and at Wad Medani 18 : 11.

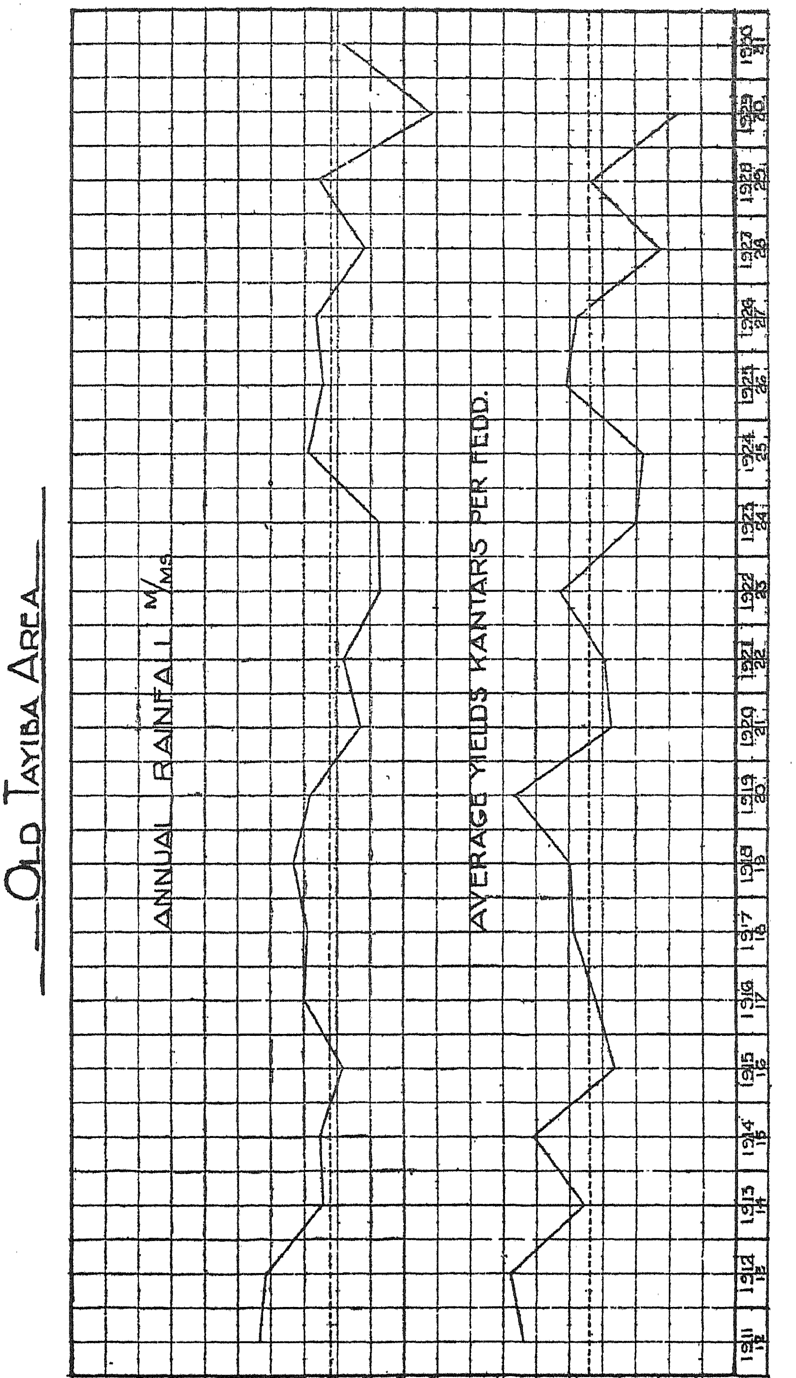
11. The all-over average yield for nineteen seasons (including 1929-30) on the "Old Tayiba" area is 3·6 kantars per feddan. For the last ten years it is 3·18 kantars, and for the last five 3·20 kantars per feddan. This corresponds to a yield of 3·73 kantars for the whole irrigated area.

12. Such a yield is sufficient at any reasonable level of cotton prices to ensure the success of the scheme.

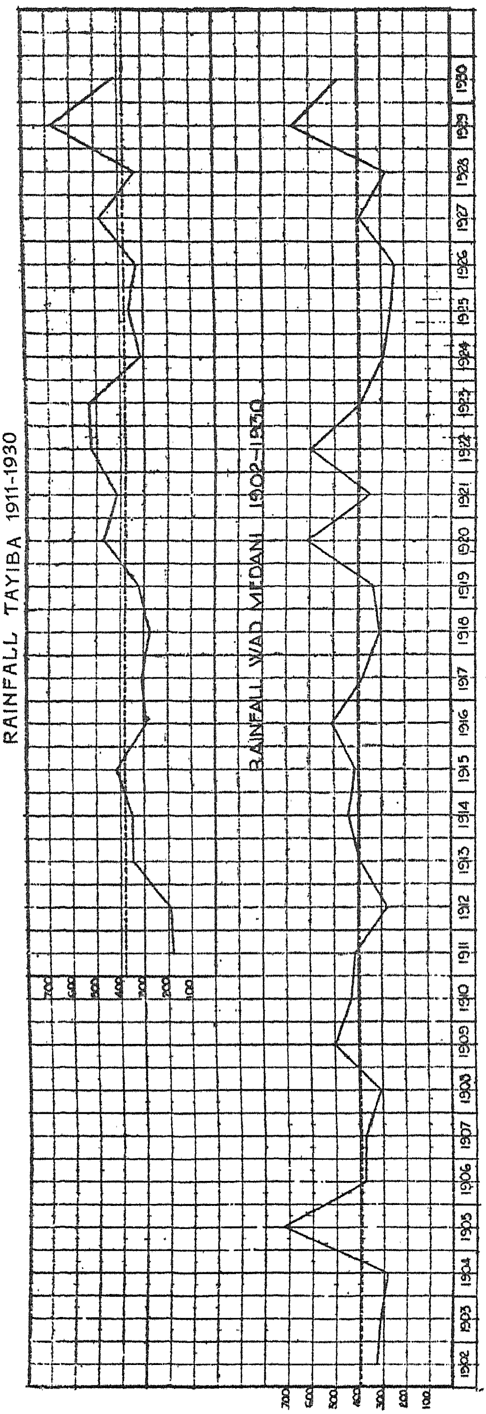
13. It remains to be proved, however, whether the severity of the Leaf Crinkle infection is determined by the nature of the season's rainfall, or whether it is an entirely new factor for which special allowances must be made in estimating future prospects.

The season now commencing should throw some light on this problem. The rains promise to be light rather than heavy, and the various measures taken with a view to keeping the Leaf Crinkle disease in check should have an opportunity of exercising their fullest effect.

Received September, 1931.


OLD TAYIBA AREA
ANNUAL RAINFALL M/MS
AVERAGE YIELDS KANTARS PER FEDD.
100
200
300
400
500
600
700
6K
5K
4K
3K
2K
1K
1911 12
1912 13
1913 14
1914 15
1915 16
1916 17
1917 18
1918 19
1919 20
1920 21
1921 22
1922 23
1923 24
1924 25
1925 26
1926 27
1927 28
1928 29
1929 30
1930 31

No. 1.


RAINFALL TAYIBA 1911-1930
RAINFALL WAD MEDANI 1902-1930
700 600 500 400 300 200 100
1902 1903 1904 1905 1906 1907 1908 1909 1910 1911 1912 1913 1914 1915 1916 1917 1918 1919 1920 1921 1922 1923 1924 1925 1926 1927 1928 1929 1930

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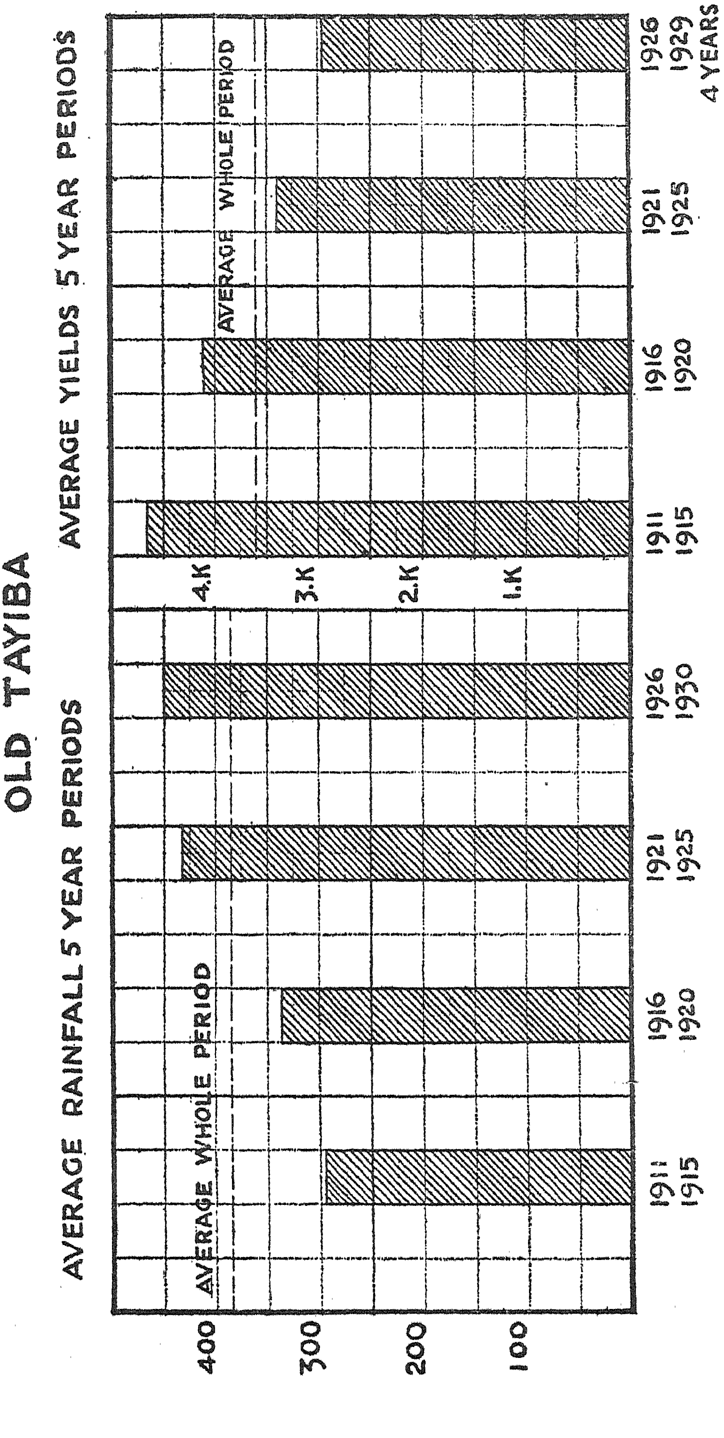
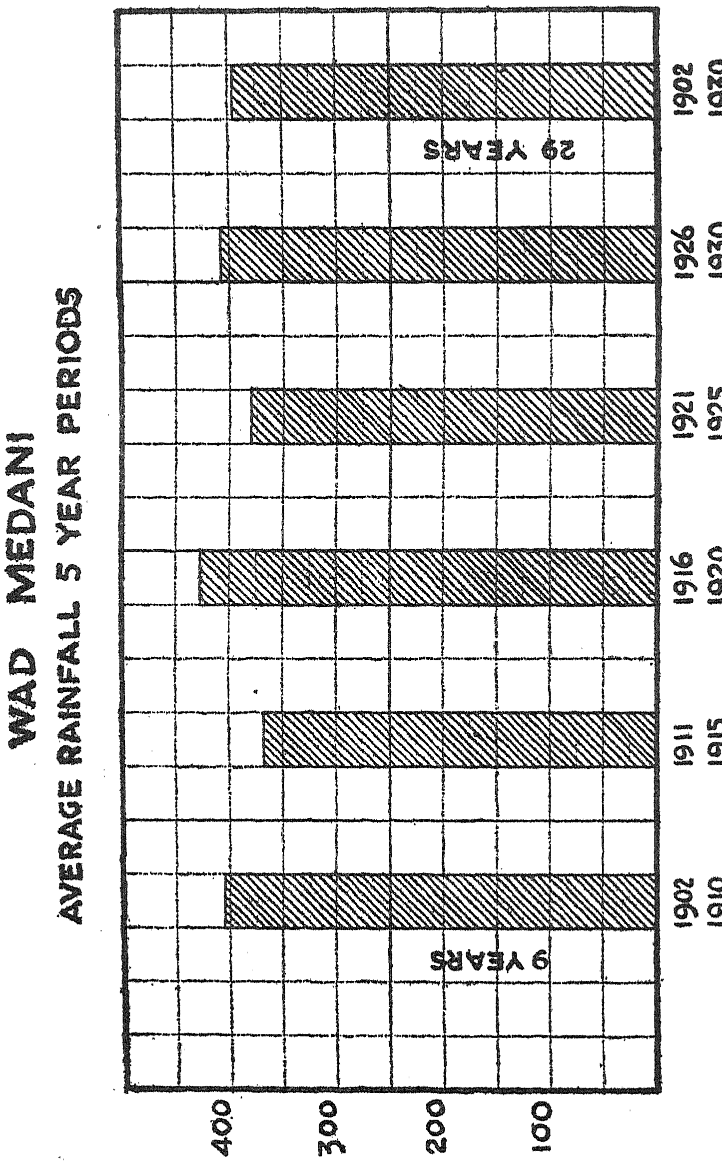
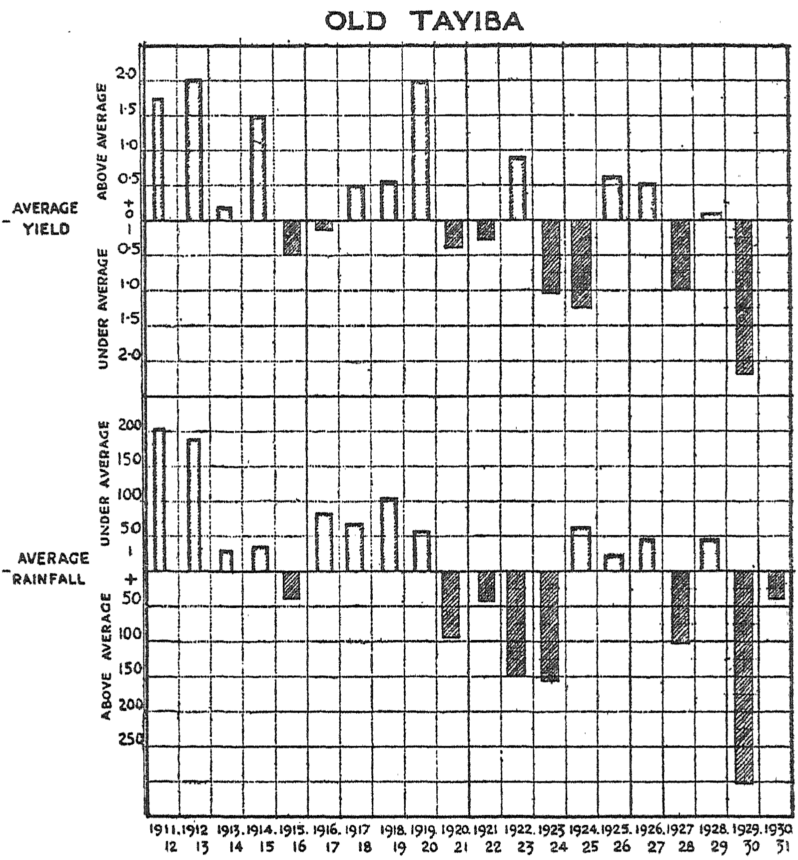

OLD TAYIBA
AVERAGE RAINFALL 5 YEAR PERIODS
AVERAGE YIELDS 5 YEAR PERIODS
AVERAGE WHOLE PERIOD
AVERAGE WHOLE PERIOD
1911 1915
1916 1920
1921 1925
1926 1930
1911 1915
1916 1920
1921 1925
1926 1929 4 YEARS
400
300
200
100
4.K
3.K
2.K
1.K

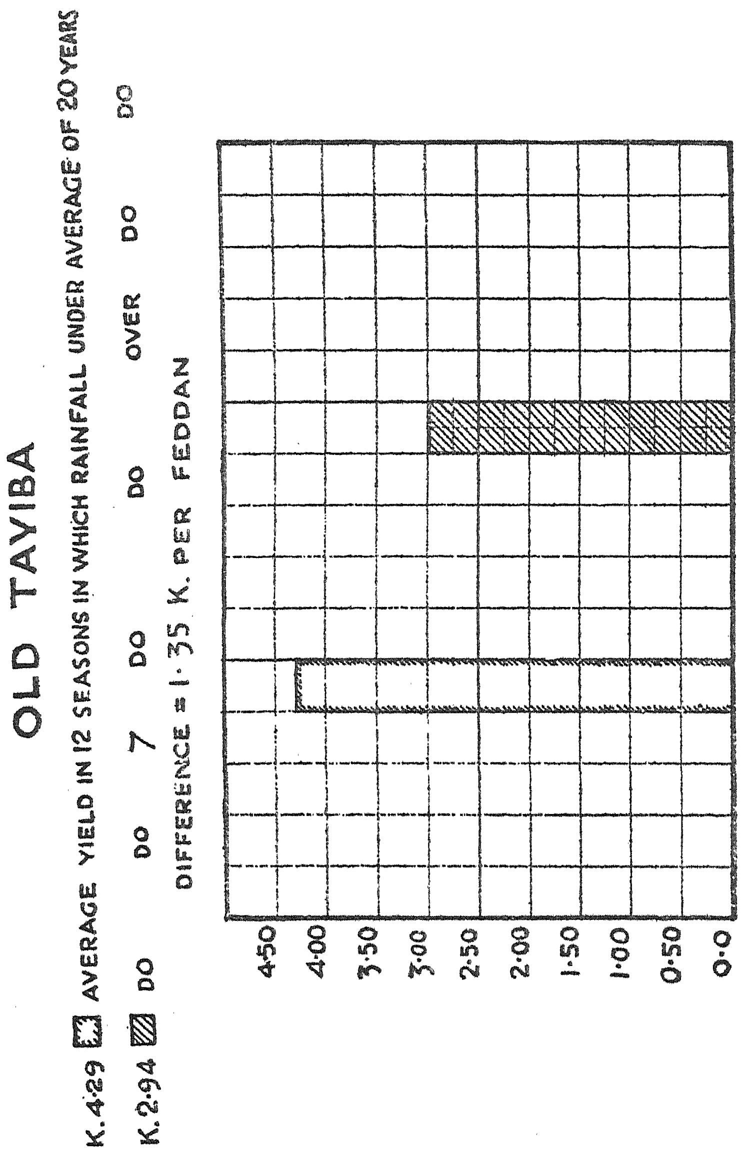
No. 3


WAD MEDANI
AVERAGE RAINFALL 5 YEAR PERIODS
400
300
200
100
9 YEARS
29 YEARS
1902 1910
1911 1915
1916 1920
1921 1925
1926 1930
1902 1930

Nº 4


OLD TAYIBA
AVERAGE YIELD
ABOVE AVERAGE
UNDER AVERAGE
2·0
1·5
1·0
0·5
+
0
-
0·5
1·0
1·5
2·0
AVERAGE RAINFALL
UNDER AVERAGE
ABOVE AVERAGE
200
150
100
50
-
+
50
100
150
200
250
1911. 12
1912 13
1913. 14
1914. 15
1915. 16
1916. 17
1917 18
1918. 19
1919. 20
1920. 21
1921 22
1922. 23
1923 24
1924. 25
1925. 26
1926. 27
1927 28
1928. 29
1929. 30
1930 31

No 5


OLD TAYIBA
K. 4·29 AVERAGE YIELD IN 12 SEASONS IN WHICH RAINFALL UNDER AVERAGE OF 20 YEARS
K. 2·94 DO DO 7 DO DO OVER DO DO
DIFFERENCE = 1·35 K. PER FEDDAN
4·50
4·00
3·50
3·00
2·50
2·00
1·50
1·00
0·50
0·0

Nº 6

THE WORLD'S COTTON MARKETS

BY

JOHN A. TODD, M.A., B.L.

[In the following article (reprinted from *Trop. Agriculture*, May and June, 1931, by kind permission of the Editor) the author has treated the subject in such a clear and concise manner that we think it will prove of considerable interest to our readers.—Ed.]

In a previous article (" Cotton Prices—Supplies and Consumption," *Trop. Agriculture*, vii., 12, 1930) the writer discussed the movements of cotton prices which have made the year 1930 one of the most remarkable in modern history. Since that article was written (in September, 1930), things have gone from bad to worse, and cotton prices have touched the lowest figure since 1911, except, of course, for the brief period of total collapse in the early months of the war, but even these two previous records were not much lower than 1930. Other commodities have been even worse; silver and rubber have established new low records for all time, while wheat has been lower than anything recorded since the seventeenth century.

Elsewhere* the writer has recently been discussing the causes of this world fall of prices in which cotton has had its full share; but while these general conditions have admittedly been the dominant factor in cotton prices during the past year, those whose livelihood depends on cotton are more directly interested in the particular conditions affecting their own staple, and in the world's markets through which these conditions operate. It has therefore been thought desirable to try to give cotton growers a fairly simple account of what that system of markets really is. It is perhaps natural that when the grower is not pleased with the price he gets he should blame the marketing system; and in recent years there has been, especially in America, an enormous amount of criticism of the cotton markets, especially the Futures markets of the great world centres, much of which has, in the writer's view, been " barking up the wrong tree." In this article, therefore, he proposes to attempt a description of the whole process of cotton marketing from the grower to the spinner, and to show how these markets work in fixing the price.

The question really resolves itself into two: (1) What are the considerations, both of demand and supply, which affect the value

* " The Fall of Prices." Oxford University Press, 1931.

of cotton in general or of any particular cotton; and (2) How do the various world's markets operate in ascertaining these values? Under the first heading the primary question is how, what may be called, the intrinsic value—*i.e.*, the spinning value—of any particular cotton is fixed. Those who are familiar with the work of Dr. Lawrence Balls on this subject, particularly his "Studies of Quality in Cotton" (Macmillan, 1928), will know that this question is still very far from being scientifically answered; but it will serve the purpose to say that the prime factor in the spinning value of any cotton is length of staple, though this is complicated by considerations of strength, uniformity, and that very vague quality which the cotton buyer describes as "character." Again, the market value of cotton is affected by its "grade," in the limited sense in which the cotton trade uses the word—*i.e.*, its condition and colour, and particularly the quantity of dirt and foreign matter which it contains and which must be removed in the cleaning process. This, with the question of short staple, which must be taken out in carding, affects the percentage of waste from any given sample of cotton, which of course directly affects its value to the spinner.

The range of quality of the numerous cottons is enormous, the staple, for example, running from $\frac{3}{8}$ in. for the shortest Indian varieties to over 2 in. for the best Sea Island, and the uses to which these different kinds of cotton can be put vary as greatly. Every spinner must have cotton good enough for the particular kind and quality of yarn he has in view; but no spinner wants to use cotton which is better, and therefore more expensive, than is necessary for his purpose. The first business of the cotton market, therefore, is to see that every bale of cotton finds its proper home—*e.g.*, if it is good cotton, the broker's business is to find a spinner who requires good cotton for a fine yarn, which will justify paying a good price for the cotton. But many fabrics require only a low-grade yarn which must be cheap; and it is the broker's business to find the cheapest possible cotton that will serve that purpose. Thus every different type of cotton is competing with every other variety, and substitution of one variety for another is the order of the day, especially in recent years.

But competition and substitution are not confined within the range of different types of cotton. Cotton of all kinds has to compete with other fibres—*e.g.*, silk, wool, linen, and now most particularly with artificial silk—for modern fashions include an enormous range of fabrics, some of which may consist of different fibres like cotton and artificial silk together; and the changes of fashion are constantly

affecting the strength of this competition—*e.g.*, in one season the demand may be all for mixed fabrics, while in another there may be a swing over to fabrics which are all artificial silk or all cotton. Again, within the range of different types of cotton, demand may change greatly. At times the demand seems to be all for short cottons, and longer stapled varieties are a glut in the market; while at other times the demand seems to swing quite the other way, and low grades are at a discount. It is the cotton broker's business to be well informed of all these changes and how they affect the demand for the different staples and types of cotton.

But all the time he has to keep constantly in touch with the other side of the market, the fluctuations of supply—*e.g.*, not only the major question of the supply of American cotton which, as explained in the previous article, still dominates the world's markets for cotton as a whole, but also the particular movements of the supply of different kinds of cotton, such as the relative quantities of Sakel and Uppers in Egypt, including the Sudan, the amount each year of the Mississippi Delta long staple cottons, the failing supply of Texas 1⅛ in. and the extent to which it can be replaced by East African cotton or Argentine or Russian, and so on; or the improving qualities of certain Indian varieties which put them in a position to compete with American cotton.

All this is the business of the Spot market, and it may be said without hesitation that in the Liverpool Spot market the necessary organization of such a market has been carried to a point about as near perfection as anything could be. The system under which one class of brokers, known as Buying Brokers, confine themselves almost entirely to acting as agents for the spinners, giving them the full benefit of their accumulated experience of the qualities of the cotton, the kind of cotton that the spinner wants for his particular work and the whole market conditions on the side of supply, is one of the best examples of the advantages of specialization. Under this system Lancashire is exceedingly well served, for Liverpool is the largest Spot market in the world, and literally every kind of cotton that the world produces is dealt in there. But Liverpool is only, as it might be called, the final Spot market. From the time the cotton is grown till it reaches Liverpool it has passed through many minor markets, and it is admitted that the conditions in many of these primary markets leave a great deal to be desired. Take, for example, American cotton. The American Cotton Belt covers an area of about 700,000 square miles spreading through eighteen states. Over the greater part of this area the first market, and the only one that

most of the growers are in touch with, consists of the little village or small town market to which the planter brings in his cotton, probably one bale at a time on his own waggon straight from the ginnery. When he left the plantation the waggon contained 1,500 lb. of seed cotton, the result of one or more days' picking, and after waiting at the ginnery, perhaps overnight, he gets it back in a 500 lb. bale of lint. With this he proceeds to the village market, which is simply the main street of the village, where he finds a number of "street buyers," one or more of whom will sample his cotton and make him a bid, based on the latest quotations from New Orleans or New York, which the buyer knows but the planter probably does not. These buyers may be representatives of a big shipping house in the nearest large town such as New Orleans, Dallas or Atlanta, but some of them are merely "scalpers" who buy as many bales as they can raise credit for, in the hope of reselling them to a larger house at a small profit. The local banker or storekeeper is also a potential buyer, especially as one of them has usually advanced money to the grower.

In fixing the price, very little attention is paid to the staple of the cotton, and not very much to the grade, for it will hardly be believed that a great many even of the buyers themselves are entirely unqualified to give a reliable verdict on the staple of the cotton, while the planter knows even less about it. In America there has grown up a system known as "hog-round buying," under which all the cotton is bought on a rough average for the district. The buyers know roughly what kind of cotton is mostly grown in that district, and they fix a price which represents approximately the value of such cotton, allowing a little margin for clean white cotton as against dirty weather-stained cotton, and of course they take care to see that the price they pay is a safe average for them. The result is that any planter who has grown better staple cotton than his neighbours gets nothing extra for it, and this system is probably the greatest single obstacle that those who are trying to improve the staple of cotton have to fight against in every country.

When the cotton reaches its concentration point it is gone over by the owners, who sort it out into lots of, say, 100 bales of about the same grade and staple, and proceed to dispose of it as best they can to merchants or spinners either in America or abroad, offering to the buyers either on sample or sometimes by "type," which is really just a standing sample. In America this habit of selling on type is not often used for more than a few months, but in Eygpt the types are permanent and are maintained from one season to

another, often for many years. In this process of lotting out the shippers may secure a good many bales of fairly good staple cotton, the value of which will be well above the "hog-round" price they paid for all they bought; but if their buyer has not done his work well, they may be landed with a great many bales of poor cotton which will have to be sold at a loss or may lie on their hands unsaleable for a long time.

It is difficult to avoid strong language in describing this system, which is just about as far away from the proper functions of a market as anything could be. There are, of course, exceptions—*e.g.*, there are what the merchants know as "staple points," districts where they can rely on the bulk of the cotton being of decent staple—and there are also some merchants who buy on "staple"—*i.e.*, who give the proper price for every bale; but this, of course, restricts them to dealing at the staple points, because they cannot have buyers in every small town simply on the off chance of picking up a few odd bales of staple cotton. Again, of course, any planter who is big enough to forward his bales to a reputable firm in one of the big centres will get the proper price for it. But the small planter cannot do this, partly because he is always in debt and must sell as soon as possible; and it is this state of affairs which has given the strongest handle for the development of the Co-operatives, whose first claim is that every bale sold by the planter to them is properly graded and stapled, is lotted with similar cotton and is sold in the best market available.

It is, of course, only fair to say that the crux of the problem is the enormous size of the American Belt. Cotton grading is a very highly skilled occupation, and those who possess that skill must be well paid. To station a skilled grader in every small town in the Belt is not practicable, especially as his services would only be required for a few months in the year. The problem, therefore, can only be solved by some kind of government or co-operative action; and the American planters are not fond of government action and are very poor co-operators.

It is probably not going too far to say that in very few other countries is the primary marketing system quite as bad as it is in America. In India, where the area of the Cotton Belt is equally large and the planters still more primitive and economically weak, the Government has done a great deal to help the marketing system and has even in some cases—*e.g.*, the Punjab—organized local markets through the agricultural officials which have been of great assistance, especially in helping to establish new varieties of cotton. In Egypt,

also, the Government has made many efforts to help the fellah. In the Sudan grading and marketing is entirely in the hands of the Government. In West Africa the B.C.G.A. practically bought the whole crop at fixed prices, which were always as favourable as possible to the native grower. In Uganda marketing is also under a certain amount of government supervision. In South Africa, again, the grading is largely in the hands of the Government. In the West Indies the B.C.G.A. have done a great deal to help the growers of Sea Island cotton, though the problem there is extremely difficult owing to the fact that the islands are so scattered and communications so poor. As to foreign countries, in Peru the industry is mostly under the control of large British firms, but in other Latin-American countries the marketing conditions leave a great deal to be desired.

Between the primary markets and the final Spot markets, such as Liverpool, there is, of course, a long way for the cotton to travel, but it may be said briefly that that part of the business is on the whole very well handled and with a minimum of cost in the way of middlemen's charges. In Egypt, for example, many of the exporting houses are branches of, or are closely connected with, the merchanting houses in Liverpool or on the Continent, and such houses have now extended their interests to new countries like Uganda, and have long been established in Peru. The main cost is freight, and except for the many up-country districts in Africa where the cotton has a long land journey to the sea, the total expenditure on transport is relatively not very heavy. The ginning and baling charges are, of course, incurred at the very outset of the whole process of marketing. In many countries, as in America, it is done at the charge of the planter before he sells the cotton. In others, such as West Africa, the planter sells his cotton in the seed; and the buyer, who in those cases generally owns the ginnery, gins and bales the cotton. It may be added that in these cases the baling is generally much more satisfactorily done, for the baling of the crop in America is one of the worst features of the whole system of handling the crop.

The Futures Markets.

So far for the various stages of the marketing of actual cotton. We have now to deal with the other and equally important side of the world's system of cotton markets—namely, the Futures markets. To explain the function of these markets it is necessary to recall that the objects of a marketing system are threefold: (1) To ascertain

the proper price of every item of the commodity which passes through the market; (2) to secure uniform prices for similar cotton throughout the whole world market, so that, for example, American cotton will not be dear in Liverpool while it is cheap in New Orleans, or that Punjab-American, if it is really as good as American, will not be selling at an unfair discount; and (3) to maintain as far as possible the stability of prices over periods of time, by smoothing out the inevitable fluctuations due to the variations of supply and demand. The last two of these functions can only be fulfilled by a system of communication which enables all the sellers and all the buyers throughout the whole cotton world to know at any moment what price their cotton or similar cotton is fetching in any part of the world. Such communication must nowadays be by telegraph, and one of the main purposes of the great organized cotton markets of the world is to maintain such communication, so that every scrap of information or every breath of opinion as to the prospects of supply or demand may be instantly communicated to all the other markets. Thus a Washington Bureau Report issued simultaneously to all the representatives of the Press and cable companies in a small room in the Department of Agriculture at Washington, exactly to a second at eleven o'clock on the morning of August 8, is, within a matter of seconds, communicated to every cotton exchange not only in America and Europe, but also to Alexandria, Bombay, Japan and all the minor producing countries throughout the cotton world; and when after twenty minutes' interval the big markets reopen, their views of the effect of that report, as shown by the movement of prices, are instantly communicated to each other and to all the rest of the world.

But how is it done? What price can be instantaneously flashed all over the world, for obviously only one price, or at the most two or three, can possibly be so treated. The answer is that the cabled quotation is the "Futures" price of Middling American cotton, for the price of American cotton dominates the world price of cotton of all kinds, and every change in the price of American is promptly reflected in the revision of the price of every other variety. In the case of Indian and Egyptian there are also Futures markets in Bombay and Alexandria respectively, and in Liverpool there are Futures markets for Egyptian, East Indian (started early this year) and also for Empire cotton. What, then, is this Futures price? What does it mean, and how is it fixed?

To answer this question it is necessary to explain just what a Futures contract is, for popular opinion on this point is entirely at

sea. In the first place, the apparently obvious distinction between Spot and Futures contracts—namely, that one is for immediate delivery and the other for future delivery—is entirely misleading. As a matter of fact, contracts in the Spot market may be for deferred delivery over as much as twelve months ahead—*e.g.*, a contract for, say, 100 bales in each month for a year ahead, which is popularly known as selling "round the clock." On the other hand, a Futures contract for the "near month," as it is called, might be completed by delivery within the current month, and conceivably might be followed by a tender almost the same day. Again, the man in the street thinks that Futures are pure speculation or just gambling, because these contracts are not intended to be completed by delivery but merely to be settled on differences. But while as a matter of fact many Futures contracts are cancelled by buying in or selling out before the date provided for delivery, yet the contract is in form just like any other contract for the sale of actual cotton. It is a contract for the delivery of 100 bales of cotton within a certain month and at a price stated; and everyone in the cotton market knows that the buyer of such a contract is liable to have cotton tendered to him if he lets it run into that month, while the seller knows that he will be called on to deliver the cotton by the end of that month if he has not previously bought in a similar contract. The man in the street who merely takes a "flier" at cotton when he thinks it is going up may not know this, but he knows that he can sell out before the due date at a profit or a loss.

The fundamental difference between contracts in the Spot market and those in the Futures ring is that a Spot or C.I.F. contract (the latter being a contract for the sale of cotton to be imported) specifies exactly, either by sample or description, the particular kind of cotton to be delivered under the contract, while a Futures contract might be called a "basis" contract; the contract merely specifies the basis price of Middling American cotton, but the buyer has the right to deliver anything above or below that grade (within certain limits), and the price to be paid for the cotton actually tendered will be decided by arbitration at certain differences, expressed in decimal points of a penny per pound and hence called "points on" or "off" the basis price of Middling American.

The advantage of this peculiar form of non-specific contract is that, just because of its vagueness, anyone can buy it or sell it, with the result that the volume of trading is enormous, and this becomes an argument in a circle. Just because the market for such contracts is so large it has come to be very widely used for another purpose,

called "Hedging." Suppose, for example, that a merchant in Liverpool has imported 100 bales of good staple American cotton at a price considerably above the price of ordinary Middling cotton, and for it he hopes to find a buyer at its proper price; but it will take time, first to get the cotton brought to Liverpool and then to find the particular spinner who wants just that class of cotton. In the meantime, however, owing to some change in crop prospects the price of all kinds of American cotton might fall very substantially, and the imports stand to lose heavily while he is waiting. If, however, when he buys the 100 bales he sells 100 bales of Futures, then, whatever happens to the price of cotton in general, he will be protected against loss because when he comes to sell his actual cotton he can buy in his Futures contract at a profit which will cover the loss he has made while holding the actual cotton. But the possibility of such a hedge depends on the fact that he can go into the market and sell Futures at any moment, and when he has sold the actual cotton, go into the market and buy the Futures contract back again whenever it suits him. In other words, the system of hedging depends absolutely on the existence of a large free market for such Futures contracts, in which there will always be buyers and always sellers at a price.

This volume of Futures business is maintained primarily by the increasing use of hedging by all kinds of people interested in cotton—*e.g.*, a spinner who is offered a contract for yarn deliverable over many months ahead cannot take the risk of accepting it unless he has already secured his cotton; but to do so would involve a heavy outlay of capital and expense for storage. If, however, he buys Futures he has no capital outlay, yet he is insured against the risks of the market rising against him before he buys the actual cotton. Again, a spinner who in order to keep his mills running has made for stock a large quantity of yarns which he cannot sell in the meantime, is running a grave risk if the raw cotton market goes down; but by selling Futures he can cover himself against this risk, for if the market falls and he loses on the price of the yarn stocks he makes a profit on his Futures contract when he ultimately sells the yarn and buys in the contract. These are merely illustrations of the innumerable interests in cotton which may be covered or insured by the various parties through a hedge, which may therefore be defined as a collateral contract by which any party interested in actual cotton may insure himself against the risk of fluctuations in the price of raw cotton; and so widely has the practice of hedging been extended that it may now be assumed that every contract which involves

an obligation on someone to buy or sell actual cotton is covered by a hedge contract in the Futures market.

It may be asked, however, how it comes about that there are always just about as many buyers as sellers or *vice versa* in the Futures market. The answer is that, in addition to those who wish to hedge their interest in actual cotton, there are in the market many speculators in the best sense of the word who, "taking a view" of the prospects of cotton, are prepared to buy Futures when other people wish to sell, in the hope of selling later on at a profit when other people wish to buy; and the existence of a volume of such intelligent anticipation is essential to the existence of the Futures market. Thus, in the autumn, when the bulk of the American crop is moving to market and all the exporters are buying actual cotton in the Belt and hedging every 100 bales they buy, the whole weight of the crop is thrown on the Futures market; and the actual demand from spinners and importers in the consuming countries could not take it up without the help of legitimate speculation by those who are prepared to carry the crop until later on in the season when actual consumption will take it off their hands. These speculators, therefore, "make the market," which would otherwise be all one way for half the year and all the other way for the other half, which, of course, would be a very bad market.

In addition to this legitimate speculation, which is really investment buying, there is, of course, in every Futures market a certain amount of outside speculation by people who have no interest in actual cotton at all, and merely wish to have an occasional "flutter" in cotton, generally when something spectacular has happened to the crop which they think will put prices up. Such speculation is of doubtful advantage because it is usually very ill-informed, and the tendency is for such gamblers to follow the crowd and carry things to extremes. But even this kind of buying has its uses, for every additional buyer or seller helps to make a market, and these people are usually the heaviest losers when the break comes.

It only remains to mention another very important class of speculators in the market—namely, the "Jobbers." These are people who, being very closely in touch with the market, watch the smallest fluctuations from hour to hour, and generally confine their operations to a single day. In Liverpool, for example, they will sell in the morning when there is a pressure of buying orders from Lancashire and buy in again in the afternoon when hedge sales begin to come in from New York; for it must be remembered that New York is five hours behind Liverpool, and their opening at 10 a.m. does not

come through to Liverpool until three o'clock in the afternoon. These jobbers also help to make a market and serve a very useful function.

Such, then, is the general structure of the Futures markets. They are focussing points of supply and demand, both present and prospective, and their effect is on the whole to minimize the fluctuations of the price of cotton in general by anticipating the changing conditions of supply and demand. But the existence of such markets also serves what we have described above as the second function of a world market: they keep the various markets in touch with each other and communicate any change in prices all over the world immediately. Thus it is Futures prices that are kept uniform by the cable system, and Spot prices follow the Futures market, so that the maintenance of uniform prices for actual cotton is achieved through the Futures market. The next question, therefore, is the effect of the Futures market on Spot prices and *vice versa*. Is it the actual conditions of supply and demand, as affecting the Spot markets, which are reflected in the fluctuations of the Futures markets; or is it, as some people believe, that the price of cotton is fixed in the Futures markets, and the values of actual cotton are dragged up or down, regardless of the real conditions of supply and demand, by gambling in Futures?

The answer to that question may best be found by returning for the moment to the Spot market to see how it uses the Futures market in its work of selling actual cotton; and to explain this fully it is necessary to enter into a rather detailed account of the methods of the Spot market. It will be remembered that the Futures contract affects only the basis price of Middling American, but very little actual cotton would come exactly within the description of "Middling cotton, fair staple," which is the basis of the contract. Most cotton is either better or worse than that, and the cotton market, as already mentioned, has developed the habit of expressing these differences of value in "points on" or "points off" the price of Middling. The universal adoption of this practice, combined with the universal use of hedging by the merchants, has produced a peculiar result. When a spinner comes to buy cotton he is shown samples, but the prices are never stated in actual pence. All he is told is that this cotton is, say, "150 on May," meaning that if he buys that cotton in February for delivery in May, the price he will have to pay will be 1½d. a lb. above the Futures price for May. Now very often the spinner hopes to require that cotton some time between now and May, but he may not have sold the yarn which he would make out

of it, and rather than buy the cotton and pay for it, it suits him better to say something like this: "All right. I will take that cotton some time between now and May, but you must leave it to me to say when I want it." This is known as a "Spinners' Call" contract, and it means that when the spinner gets an offer for the yarn he will calculate his selling price on the basis of the Futures price for May, whatever it may be by that time, plus the 150 points on. When he fixes the yarn sale he telephones his broker to "call 100 bales" under that contract, whereupon the broker fixes the price by going into the market, buying back his 100 bales of Futures, and then invoicing the cotton to the spinner at the price he paid plus the 150 points.

The almost universal adoption of this system has led to the rather puzzling result that merchants in Liverpool do not deal in cotton at all, but merely in "points on," and their whole business is to make their profit out of these differences. That is by no means easy, because not only does the price of cotton, as shown by the Futures quotation, vary all the time, but the amount of the differences which a particular grade or staple of cotton will command above or below the basis price also varies, and it may vary quite differently from the movement of the basis price. Thus cotton may be falling but the premium for good staple cotton may be rising at the same time. This risk of the variation of the premiums or discounts on different grades of cotton is one which the merchant cannot cover by hedging, because his hedge contract only protects him against variations in the basis price. Unfortunately the cotton markets have here introduced a complication which makes it extremely difficult for the outsider to follow their jargon. They have got into the habit of speaking of these differences or "points on" as "basis," which is simply a shorthand method of saying points on or off the basis price. When therefore they say the "basis" for good staple cotton is rising, they mean that the premium commanded by such cotton is greater; but the actual price of such cotton may be falling, because of a fall in the general price of cotton as represented by Futures. This is the explanation of such statements as that "the basis is rising" or falling; and again, it explains the cryptic statement that "basis cannot be hedged."

Thus the Liverpool Spot market deals only in basis. The price of cotton in general is of very little importance to the Spot man; he has covered all that by his hedge contract, and his business is to make his profit out of the basis, in his sense of the word. This may seem to the outsider an entirely unnecessary complication, but it

has a great advantage. In effect it means that the Liverpool market (and other big markets are similar) is divided into two separate markets: (1) The Futures market deals with the price of cotton in general, and has little interest in the particular fluctuations of supply and demand that affect different varieties of cotton. (2) The Spot market practically ignores the price of cotton, and confines itself to the variations in value of different cottons. The result is specialization, and the development of an extremely high degree of skill and knowledge, for each section of the market is left free to mind its own business, and becomes expert in calculating the innumerable risks and chances which affect prices in its own department.

But while the two sections of the market are thus separately organized they are intimately bound up with each other, so that the movement of the actual conditions of supply and demand in one market is very promptly reflected in the other. The link between Spot and Futures lies in the fact that every sale of actual cotton is promptly covered by a hedge contract in the Futures market. Thus when the bulk of the crop is moving to market during the harvesting season the weight of hedge selling tends to depress the Futures market, unless there is an unusually active offtake of actual cotton by spinners. On the other hand, when the spinners are "calling" cotton freely the result is a great deal of price fixing—*i.e.*, Futures being bought in, so that prices rise. Further, any tendency for the Futures market to run away from Spot conditions in either direction is always checked by the fact that the Futures contract is after all a contract for the delivery of actual cotton, and if Futures prices get out of range of Spot values the other party to the contract can always resort to the actual transaction. If, for example, Futures get too low, the holders of the contract may decide to take up the cotton, and those who have sold "short" may find it difficult to lay hands on the actual cotton to fulfil their contracts, as in the case of the squeeze in May Futures last year, described in the previous article. On the other hand, if Futures go too high, the sellers can always tender the actual cotton; and, as a matter of fact, experience prior to 1930 seemed to show that this was the more normal course of events, and the "fear of tenders" often proved a depressing factor because the "longs"—*i.e.*, those who had bought contracts—were afraid of getting delivery of undesirable cotton. It sometimes happened, therefore, that the presence in the market of quite a small quantity of cotton, which for some reason was a drug in the market at the time, would prove a depressing factor for several months, because as each month came round there was the fear that

it would be tendered. Thus the Spot and Futures markets act and react on each other, and the correlation of prices is on the whole remarkably good.

It seems, then, that cotton growers generally have not much cause to complain of the way in which the great organized cotton markets of the world handle their product. The truth is that most of the faults in the system lie very near the growers' own door. It is the primary markets that are lacking in proper organization, and the cure for that is no easy matter. The recent attempts by the American and Egyptian Governments to help the growers to improve conditions at their own end of the business have unfortunately resulted in these Governments being dragged willy-nilly into intervention on a very large scale in the working of the organized world markets, which so far has resulted mainly in disorganizing these markets very badly. How the whole business will end is still very uncertain, but the conclusion is that it is foolish of the growers to try to blame all their troubles on other people at the other end of the marketing system. They must put their own house in order.

FOLK-LORE FRAGMENTS—IV

BY

J. C. MAY.

The Native Commissioner and Swewe were once again making a tour through the old Chief's villages, with a view to seeing what progress had been made in the preparation of land for next season's cotton crop, in addition to the gardens required for food crops plus that modicum of grain for beer-making that is so essential to native happiness. So far the doctrines of prohibition have not found much acceptance in Central Africa. Cotton prices during the previous season had been considerably reduced from those of two years ago, and the Native Commissioner had spent much of his time during the last few weeks in trying to convince the native that the white man did not reduce prices in order to increase his own profits. How far he had succeeded he was by no means sure, seeing that the rather unanswerable argument had again and again been brought forward that no reduction had been observed in the prices of Manchester goods.

Having come to the end of a long valley containing stretches of cultivated land, Swewe suggested that they should make a circuit to the left through the bush in order to return via another valley in which there was a considerable number of gardens. There being nothing to look at in particular for the moment, the Native Commissioner turned the conversation to a subject that interested him keenly—namely, native law and customs and folk-lore stories.

The study of these stories which have been handed down by word of mouth from generation to generation affords the European an opportunity of gaining an insight into a side of native outlook and character that he may never appreciate from ordinary everyday contact with the people of his district. Like Æsop's fables, the stories, nearly all of them, illustrate a moral, and in order that they may appeal to the children and linger in their memories, the characters in the stories are animals, birds, and insects, and not, for the most part, human beings.

The Native Commissioner had only recently come across a few examples of the class of story that inculcates thrift, like our own

nursery rhyme suggesting that one ought not to leave a pin lying on the floor, and he took the opportunity of seeing whether he could extract a new one from Swewe, and one that chiefly concerned human beings. After a short pause for reflection, Swewe said: "Bwana, I can tell you a story which shows that things which are picked up may prove to be extremely useful.

"Long, long ago, there lived a Chief who decided to move his village, and after paying particular attention to all the rites necessary to secure happiness for his people in the new village and good crops in their new gardens, he led them from the old village to begin a new life on the land they had chosen some miles away. But all that was necessary had evidently not been done, and lions appeared and killed cattle, goats, and even people. Then the Chief called the lions and asked what he could do that would persuade them to leave the village in peace. The king of the lions said that he and his people would move elsewhere if the Chief would give them his two daughters. To this, after much lamentation, the Chief agreed, and he and his people built a small grass hut on the opposite hill near the rocks in which the lions were living, and left the two maidens there in the evening.

"Now it so happened that, just at this time, two men had set out from a village some miles away to visit a friend in the Chief's new village: one was a hunchback and one was blind. As they journeyed, the hunchback said to his companion, 'I see a tortoise in the path,' and the blind man replied, 'Pick it up: it may be useful.' But the hunchback laughed and would not do so, so the blind man asked him to guide his hand to the place where the tortoise was, and he then picked it up and put it in the bag he had made from the entire skin of a small buck. As they continued along the road, the hunchback said to his companion, 'A porcupine has died here,' and the blind man said, 'Give me one of its quills.' Again the hunchback laughed at him, but in the end he picked one up, and the blind man placed this also in his bag.

"When they came within a few miles of the new village, they decided to leave the native path on which they had been walking and to go across country, as they knew that there would be as yet but few paths in the neighbourhood of the new village. Passing through the bush, they came across the skeleton of a man who had shot an elephant, but had been killed by the animal just before it died. Lying between the skeleton and what remained of the elephant was the man's gun, and by his side were his powder horn and bag of bullets and slugs. The hunchback told the blind man of what he

could see, and was urged to pick up the gun, the powder horn and the slugs, and one of the elephant's tusks. He again protested, saying, 'They will be heavy to carry, and although you say you will carry them, I know that you will give them to me soon'; but after a little while he collected what the blind man wanted and gave them to him.

"By this time dusk was falling, and they were not quite certain where the new village was, but on the opposite hill they saw the light of a fire and directed their steps thither. When they came to the fire, they found that it was just at the entrance of a grass hut, and sitting by it the hunchback saw two maidens. 'Let us rest here, for we are weary,' said he; but the maidens replied: 'We have been given to the lions, who have promised to leave our village in peace if they may eat us. You cannot stop here: they will come soon.' The blind man said: 'I can go no farther; I am very tired; I am carrying a gun and a tusk of ivory, and they are very heavy.' 'Did I not tell you,' said the hunchback, 'that you would repent you of these things that you will collect on the road?' So the men sat down by the fire, and very soon there was a roar from the thicket near at hand. 'The lions come,' cried the maidens, and the hunchback shivered with fright. Then the lions approached nearer, and the hunchback stirred up the fire; but this did not seem to frighten the lions, and one came close to the fire and said, 'What do you here? These maidens have been given to us. Go, for we would eat them.' All shrank back in terror save the blind man, who replied, 'We go not, neither shall you eat them.'

"Then something was thrown across the fire which struck the side of the hut with a loud noise. 'Now go!' roared the lion, 'for that which struck the hut was one of my fleas.' 'I go not,' shouted the blind man, and threw the tortoise at the lion. 'I give you one of mine in exchange.' The tortoise hit the lion on the head and made him pause, but he plucked out and threw across the fire one of his hairs, which fell into the fire as if it had been quite a thick stick, and sizzled up with a blaze. 'Behold,' roared the lion, 'I have thrown you one of my hairs. Do you not see it is as large as a stick, and that I am so mighty that you cannot escape?' But the blind man threw the porcupine quill and said, 'Behold, I am mightier: I throw you a single hair from one of my eyebrows,' and the porcupine quill stuck in the lion's side, and he pulled it out and thought how he could kill so powerful a giant.

"Then, being old and an eater of men, the lion plucked out one of his teeth that had been worrying him for some days, and threw

it at the man, saying, 'Here is one of the teeth whose brothers shall crunch your bones in a few minutes.' But the blind man cast the elephant's tusk, saying, 'Here is a small piece that has broken off one of my front teeth, yet the rest remains and will help to chew you up when you have the courage to come closer.'

"Then the lion rather fearfully crept closer and roared with all his might, hoping to terrify this obstinate one; but the blind man said: 'What was that you whispered? Speak again and louder, for I cannot hear you.' So the lion roared again and said: 'Let me hear you roar in order that I may know which of us is the greater.' And the blind man answered: 'So that you may know that I am greater than all beasts, come close, all of you, to the fire and put your heads together in order that you may first hear me whisper you a secret.' Then the lions crept up and lay close together, and under cover of their movements the blind man loaded the gun to the muzzle. When all was still again, he pointed the gun at them and pulled the trigger. There was a mighty roar, and all the lions lay dead.

"Then the blind man and the hunchback and the two maidens arose and went back to the village, and the girls said to their father, 'Behold, these men have killed the lions.' Then there was great rejoicing, and the two friends were feasted and slept in the Chief's hut that night. In the morning the Chief called his counsellors together, and when they had made sure that the lions were in truth dead, he said: 'What shall be done to reward these brave men?' The counsellors said that he should give them his daughters in marriage: so this was done, and they departed to build their huts just outside the village where the girls had waited for the lions.

"As they were going, the Chief gave them six cowrie shells as a dowry with his daughters, three to each. But the hunchback took four shells and gave only two to the blind man, thinking that because he could not see, he would not be able to count them. But the blind man put one in each hand and said to him: 'I heard the Chief say six shells, and behold, I have only two, one in each hand.' With his gun, he hit the hunchback in the middle of his back. The blow fell on that part of his spine which was curved, and, lo, it became straight, and the hunchback stood upright as other men. But the pain of the blow was very great, and in anger he hit the blind man across the eyes with the haft of a spear which he was carrying, and the blind man clapped his hand to his face in pain, and when he took it away, behold, he could see.

"So they clasped hands and renewed their friendship joyfully,

and their wives were rejoiced that they were married to men who were whole as other men.

"Thus, Bwana, not only did the things that were picked up save the lives of the two friends and gain them wives, but good came from the evil of the hunchback's deceit and the angry blows exchanged."

COMPARATIVE COTTON PRICES

BY

JOHN A. TODD, M.A., B.L.

In this issue we continue the record of comparative prices.

The movement of cotton prices during season 1930-31 has had comparatively little to do with the conditions of supply and demand affecting cotton itself, which, like most other staple commodities, has been almost completely dominated by outside influences, and, as will be seen from Table I., cotton has had its full share in the depression, as revealed by the Index Number of Wholesale Prices.

In the early months of the season cotton followed the general downward movement pretty closely, though from July to December cotton fell more heavily than the General Index Number. This was due mainly to the very depressed state of the New York Stock Exchange, which in December broke new low levels. At that time also the bank failures in America helped cotton on the downward grade, and the near month in Liverpool broke below 5d., which was the lowest since 1911-12. Egyptian prices, following American, were then the lowest since 1908-09, excluding, of course, the first year of the war in both cases. After the low point in December, however, there came a welcome recovery which was due rather to an improved tone in general conditions than anything affecting cotton, but during April prices once more fell sharply. The main cause of the new decline was the renewed spell of bearishness on the New York Stock Exchange, which carried their figures down even below the low level of December, and resulted in the failure of several big stock-broking houses with cotton connections in New York. Added to this there was considerable uncertainty as to the future policy of the Federal Farm Relief Board in regard to their holdings of cotton, which amounted to about 3,600,000 bales, including the holdings of the Co-operative Marketing Association. The stock figures both of American and Egyptian have reached record figures during the season, so that the situation of supply has also been an important factor in price movements. All these factors combined to send cotton lower still, with the result that in May prices went below the record of 1911. The worst, however, was yet to come, for in the early part of June Spot American in Liverpool fell to 4·56d. against 4·25d. in October, 1914, and the previous low record of

3·68d. in 1904-05. Egyptian was almost as bad, for Sakel went to 6·96 in Liverpool and 12·78 in Alexandria; but in the case of Egyptian comparison is difficult, because Sakel quotations only began in 1917-18, the spot quotation for Brown was 6·30 in January, 1915, and 6·56 in 1904-05. As this question of record prices has been of considerable importance this season, we think it of interest to give the following record of highest and lowest prices for each season since the beginning of the century.

HIGHEST AND LOWEST SPOT PRICES IN LIVERPOOL.

Season.	*American.*		*Egyptian.*		*Season.*	*American.*		*Egyptian.*	
	High.	*Low.*	*High.*	*Low.*		*High.*	*Low.*	*High.*	*Low.*
	Middling.		F. G. F. Brown.			Middling.		F. G. F. Brown.	
1899–00	6·06	3·97	8·44	5·37	1915–16	8·74	5·34	11·90	7·50
1900–01	7·38	4·28	8·25	5·44	1916–17	19·45	8·12	31·50	11·55
1901–02	5·38	4·25	7·75	5·37	1917–18	24·97	16·90	35·25*	28·56
1902–03	7·12	4·40	11·12	7·00	1918–19	25·27	14·68	30·19	26·59
1903–04	8·96	5·68	10·69	6·81	1919–20	31·16	17·60	99·00	29·50
1904–05	6·88	3·68	8·62	6·56	1920–21	27·32	6·38	70·00	13·00
1905–06	6·42	5·26	10·62	7·81	1921–22	15·21	8·22	30·75	15·50
1906–07	7·52	5·31	11·62	9·25	1922–23	17·13	12·10	19·25	15·25
1907–08	7·57	5·16	10·75	7·19	1923–24	21·64	13·25	26·95	15·35
1908–09	6·92	4·80	9·56	7·38	1924–25	18·18	12·11	38·95	24·05
1909–10	8·50	6·77	16·19	9·56	1925–26	13·63	9·17	32·45	15·00
1910–11	8·42	6·57	12·94	9·63	1926–27	10·36	6·30	20·00	13·20
1911–12	7·53	4·92	10·55	8·88	1927–28	12·67	9·17	21·95	16·60
1912–13	7·19	6·05	10·20	9·30	1928–29	11·14	9·72	19·60	15·75
1913–14	7·96	6·20	10·45	8·15	1929–30	10·66	7·27	17·75	12·05
1914–15	6·50	4·25	8·30	6·30	1930–31	7·54	4·56	12·35	6·95

* Quotation changed to F. G. F. Sakel.

After the low point touched in June, there came a very welcome recovery. President Hoover's pronouncement for a "debt holiday" came just in time, for things were in grave danger of degenerating into a panic. Cotton shared in the general recovery of almost all commodities, but the hitch which occurred in the negotiations and the result of the Seven-Power Conference proved a sharp disappointment, and once more prices fell almost to the level at which they stood before President Hoover's pronouncement. Amidst all this political and financial uncertainty came the U.S. Government's acreage figure, which was also a disappointment, the reduction of only 10 per cent. being rather less than the market had expected. Generally, favourable crop news and very small demand from consuming quarters all contributed to the lower tendency, and finally the raising of the Bank Rate in July from 2½ to 4½ per cent. was regarded as a further setback, so that the season closed with

prices at new low levels. When the first Bureau report of the season was published on August 8, however, the huge crop figure sent prices once more to new low records, indeed not far short of the low record of history (3·60d. against 2·97d. in 1894).

Table III. continues the record of prices of the various kinds of cotton in Liverpool, all of which have as usual moved in sympathy with American prices.

TABLE I.—HISTORY OF COTTON PRICES, 1899-1931.

SEASON'S AVERAGES.

Season.	*Liverpool Prices (Pence per Lb.).*					*Alexandria.*	*American Price of Upland.*	*Index Numbers of General Prices.*	
	Sea Island.	*Brazil.*	*American.*	*Indian.*	*Egyptian.*				
	Cents per Lb.	Pernam Fair.	Middling.	No. 1 Fine Oomra.	F. G. F. Brown.	Dols. per Kantar.	Cents per Lb.	Year.	
1899–00	16·70	5·06	4·87	4·40	6·81	*12·28	7·60	1900	100·0
1900–01	16·40	5·50	5·16	4·37	6·87	13·80	9·30	1901	96·7
1901–02	19·30	4·87	4·78	4·19	6·31	10·42	8·10	1902	96·4
1902–03	†25·00	5·57	5·44	4·47	8·44	13·65	8·20	1903	96·9
1903–04	28·40	5·16	6·94	5·56	8·56	16·65	12·16	1904	98·2
1904–05	27·12	5·25	4·93	4·62	7·37	13·97	8·66	1905	97·6
1905–06	26·38	6·23	5·94	5·00	9·25	15·99	10·94	1906	100·8
1906–07	36·70	6·97	6·38	4·87	10·37	19·16	10·01	1907	106·0
1907–08	35·59	6·79	6·19	5·03	8·81	18·21	11·46	1908	103·0
1908–09	23·39	5·84	5·50	4·94	8·44	15·46	9·24	1909	104·1
1909–10	32·85	8·34	7·86	6·31	13·12	23·30	14·29	1910	108·8
1910–11	35·62	8·27	7·84	7·03	10·75	20·66	14·69	1911	109·4
1911–12	23·73	6·70	6·09	5·63	9·56	17·25	9·69	1912	114·9
1912–13	25·00	7·11	6·76	6·16	9·79	18·28	12·20	1913	116·5
1913–14	23·47	7·47	7·27	5·88	9·45	19·02	13·49	1914	117·2
1914–15	22·00	5·71	5·22	4·46	7·34	12·01	7·94	1915	143·9
1915–16	27·00	8·22	7·51	6·09	10·42	19·28	11·99	1916	186·5
1916–17	50·00	13·03	12·33	10·32	21·56	37·81	18·41	1917	243·0
1917–18	80·00	24·13	21·68	18·78	‡30·97	38·52	28·86	1918	267·4
1918–19	65·00	23·96	19·73	18·13	27·85	37·20	30·36	1919	296·5
1919–20	*Peruvian*	30·00	25·31	19·23	60·34	87·81	38·21	1920	365·7
1920–21	*Tanguis*	13·24	11·89	9·20	30·24	34·50	16·08	1921	229·7
1921–22	Good	11·40	11·37	9·60	19·75	34·28	17·78	1922	185·0
1922–23	16·87	14·62	14·92	11·14	17·29	30·71	24·06	1923	185·3
1923–24	20·15	18·20	17·66	13·35	21·55	39·79	31·67	1924	193·6
1924–25	18·21	14·67	13·76	11·95	29·82	39·49	24·27	1925	185·4
1925–26	15·15	11·09	10·77	8·97	20·05	30·47	19·88	1926	172·5
1926–27	9·95	8·32	8·15	7·18	15·39	21·49	12·96	1927	164·7
1927–28	12·52	11·36	11·17	9·21	19·39	29·69	19·72	1928	163·4
1928–29	12·25	10·72	10·52	8·03	18·14	25·88	18·92	1929	158·9
1929–30	10·44	8·67	9·09	6·39	14·52	20·36	17·24	1930	139·2
1930–31	6·78	5·67	5·71	4·02	9·06	12·42 (8 months)	9·57	1931	121·4 (8 months)

* These figures are F. G. F. Brown till 1914, since then composite figures embracing G. F. Sakel, G. F. Ashmuni, and G. F. Brown.

† South Carolina.

‡ F. G. F. Sakel.

TABLE II.—SPOT PRICES OF AMERICAN AND EGYPTIAN COTTON IN LIVERPOOL, ALEXANDRIA, AND NEW ORLEANS ON THE LAST FRIDAY OF EACH MONTH.

Month.	*Liverpool.*					*New Orleans American Middling.*	*Alexandria.*	
	American Middling.	*Egyptian F. G. F. Sakel.*		*F. G. F. Uppers.*			*F. G. F. Sakel.*	*F.G.F. Uppers.*
	Pence per Lb.	Pence per Lb.	Premium per Cent.	Pence per Lb.	Premium per Cent.	Cents per Lb.	Dollars per Kantar.	Dollars per Kantar.
1928–29.								
August ..	10·47	18·85	*80*	12·80	*22*	18·50	36·37	23·68
September	10·72	17·90	*67*	12·00	*12*	18·53	34·12	21·43
October ..	10·51	18·05	*72*	12·40	*18*	18·55	35·00	22·56
November	10·97	19·40	*77*	12·65	*15*	19·57	37·87	23·06
December	10·64	19·35	*82*	12·20	*15*	19·36	37·87	23·06
January ..	10·48	19·10	*82*	12·32	*17*	18·91	36·50	21·81
February	10·49	17·85	*70*	12·10	*15*	19·00	36·62	23·43
March ..	10·96	19·40	*77*	12·80	*17*	19·75	37·50	23·81
April ..	10·23	17·95	*75*	11·86	*16*	18·59	35·00	22·56
May ..	10·20	17·25	*69*	11·38	*11*	18·52	32·50	20·68
June ..	10·33	16·20	*57*	11·18	*9*	18·76	31·62	21·18
July ..	10·58	17·05	*61*	11·54	*9*	18·89	32·62	21·06
1929–30.								
August	10·58	17·25	*63*	11·75	*11*	19·10	33·25	21·43
September	10·20	16·50	*62*	11·30	*11*	18·14	32·12	20·68
October	9·96	15·55	*56*	10·87	*9*	18·05	28·62	19·81
November	9·59	14·65	*53*	10·63	*10*	17·17	27·12	19·06
December	9·51	14·20	*49*	10·44	*11*	17·11	26·87	19·18
January ..	8·85	14·25	*61*	10·34	*17*	15·89	26·87	19·25
February..	8·49	13·55	*60*	10·11	*19*	15·16	26·37	19·18
March ..	8·44	14·20	*68*	10·27	*22*	15·48	27·37	19·06
April ..	8·74	14·30	*64*	10·42	*19*	15·54	27·37	19·43
May ..	8·58	13·65	*59*	10·11	*18*	15·45	27·62	19·43
June ..	7·74	12·55	*62*	9·58	*24*	12·85	27·62	19·25
July ..	7·47	12·40	*60*	9·44	*26*	12·75	27·37	18·62
1930–31.								
August ..	6·64	10·45	*57*	8·50	*28*	10·80	25·87	14·00
September	5·89	10·05	*71*	8·22	*40*	10·06	19·87	13·00
October ..	6·24	9·65	*55*	6·74	*8*	10·89	18·25	12·31
November	5·91	9·35	*58*	6·58	*11*	10·22	16·12	11·43
December	5·31	7·85	*48*	6·09	*15*	9·40	13·75	10·62
January ..	5·63	8·85	*57*	6·52	*16*	10·16	16·25	11·50
February	6·18	10·35	*67*	7·72	*25*	10·81	19·07	13·95
March ..	5·85	9·45	*62*	7·00	*20*	10·59	16·97	12·50
April ..	5·62	8·30	*48*	6·42	*14*	9·89	14·87	11·25
May ..	4·80	7·80	*63*	5·78	*20*	8·45	14·47	10·05
June ..	5·43	8·20	*51*	6·47	*19*	10·21	14·62	11·10
July ..	4·62	6·95	*50*	5·53	*20*	8·37	12·52	8·95
1931–32.								
August ..	3·83	5·95	*55*	4·79	*25*	6·85	10·87	8·20

TABLE III.—MONTHLY SPOT PRICES OF VARIOUS KINDS OF COTTON IN LIVERPOOL, 1928-31.

ON THE LAST FRIDAY OF EACH MONTH. FROM THE LIVERPOOL COTTON ASSOCIATION'S WEEKLY CIRCULARS.

(For American in Liverpool and New Orleans—and Egyptian in Liverpool and Alexandria—see Table II.)

Seasons.	*Peruvian.*			*Brazilian.*		*West African (Middling).*	*East African (Good Fair).*	*Indian (No. 1 Fine Oomra).*	*Percentage of Indian on American.*
	Tanguis (Good Fair).	*Smooth (Good Fair).*	*Rough (Good Fair).*	*Sao Paulo (Fair).*	*Pernam (Fair).*				
1928–29.									
August ..	11·77	11·52	12·00	10·27	10·77	10·37	13·05	8·05	*77*
September ..	11·73	11·48	12·25	10·23	10·73	10·33	12·55	7·85	*73*
October ..	11·91	11·66	13·00	10·31	10·81	10·51	12·40	7·95	*76*
November ..	12·42	12·17	13·00	10·82	11·32	11·02	12·75	8·55	*78*
December ..	12·04	11·74	13·00	10·39	10·99	10·74	12·55	8·40	*79*
January ..	11·88	11·58	13·00	10·23	10·83	10·58	12·05	8·20	*78*
February ..	11·94	11·44	13·00	10·19	10·79	10·54	11·80	8·15	*78*
March ..	12·41	11·91	13·00	10·56	11·16	11·01	12·10	8·50	*78*
April ..	11·73	11·23	13·00	9·88	10·48	10·33	11·35	7·65	*75*
May.. ..	11·70	11·20	13·00	9·85	10·45	10·30	11·25	7·55	*74*
June ..	11·63	11·13	13·00	9·68	10·28	10·33	11·20	7·75	*75*
July.. ..	11·83	11·28	13·00	9·93	10·38	10·53	11·35	7·95	*75*
1929–30.									
August ..	11·68	11·28	13·00	9·93	10·38	10·53	11·10	7·95	*75*
September ..	11·25	10·95	13·00	9·50	9·95	10·20	10·75	7·65	*75*
October ..	11·06	10·76	12·75	9·31	9·76	10·01	10·56	7·45	*75*
November ..	10·54	10·34	12·25	9·14	9·24	9·59	10·14	7·20	*75*
December ..	10·46	10·16	12·25	9·06	9·16	9·51	10·06	7·10	*75*
January ..	9·60	9·50	12·25	8·50	8·50	8·85	9·40	6·35	*72*
February ..	9·29	9·19	12·25	8·09	8·09	8·54	9·09	5·80	*68*
March ..	9·24	9·14	—	8·04	8·04	8·49	9·14	5·65	*67*
April ..	9·34	9·09	—	7·99	7·99	8·59	9·24	5·65	*65*
May.. ..	9·18	8·93	—	7·93	7·93	8·53	9·18	5·65	*66*
June ..	8·29	8·04	—	7·04	7·04	7·64	8·29	4·85	*63*
July.. ..	7·97	7·82	—	6·72	6·72	7·42	8·17	4·35	*58*
1930–31.									
August ..	7·14	6·94	—	5·94	5·94	6·59	7·54	4·10	*62*
September ..	6·54	6·44	—	5·69	5·79	5·94	6·89	3·80	*65*
October ..	6·84	6·74	—	6·09	6·19	6·24	7·19	4·50	*72*
November ..	6·51	6·41	—	5·76	5·86	5·91	6·86	4·20	*71*
December ..	6·01	5·76	—	5·36	5·46	5·36	6·36	3·75	*71*
January ..	6·33	6·08	—	5·68	5·78	5·63	6·68	4·03	*72*
February ..	7·03	6·63	—	6·23	6·33	6·18	7·23	4·58	*74*
March ..	6·70	6·30	—	5·80	5·90	5·90	6·90	4·23	*73*
April ..	6·47	6·07	—	5·57	5·67	5·67	6·67	4·13	*73*
May ..	5·60	5·30	—	4·80	4·90	4·90	5·90	3·49	*73*
June ..	6·18	5·88	—	5·38	5·48	5·48	6·48	4·14	*76*
July.. ..	5·37	4·97	—	4·57	4·67	4·67	5·67	3·84	*83*
1931–32.									
August ..	4·58	4·18	—	3·78	3·88	3·88	4·88	3·12	*81*

NOTES ON CURRENT LITERATURE

COTTON IN INDIA.

524. INDIA. *Cotton Cultivation.* (*Ann. Rpt. Emp. Cot. Grow. Corpn.*, 1931.) Research work, both in the laboratory and in the field, is continuing to receive attention in the cotton-growing areas. The Indian Central Cotton Committee has financed thirteen schemes for the improvement of Indian cotton, and has sanctioned funds for starting six more schemes during the current year. In addition, funds have been allotted for the more rapid extension and distribution of improved varieties of cotton. These activities are distributed over the Presidencies of Bombay and Madras, the Punjab Province, the United Provinces, and Central Provinces. Botanical, physiological, mycological, and entomological work is being carried on in these areas with a view to finding cottons which thrive best under local conditions, can resist attack by disease, are good yielders and have good spinning and ginning qualities. Considerable progress has been made and valuable results have been obtained.

The Sukkur Barrage was almost completed last year. An area of 11,000,000 acres will be irrigated by this means, and it is anticipated that a high proportion of the acreage will be devoted to cotton. The Bombay Legislative Council gave its approval to general measures planned for the development of the area covered by this project. These measures include the establishment of two agricultural research stations, in addition to the existing one at Sakrand, and the opening of six seed farms, four of 2,000 acres each and two of 1,000 acres each. Good work continues to be carried on at Sakrand, where the principal problem is to find the best system of farming under perennial irrigation, so as to achieve the double object of combating alkaline salt, and ensuring the maintenance of soil fertility. Experiments carried out at this research station show that the future cotton of Sind will probably be founded on Punjab-American 4F.

525. INDIAN COTTON CENTRAL COMMITTEE. In his speech at the twenty-third meeting, held in July last, the Vice-President referred to the loss sustained through the resignation, from various causes, of several members of the Committee. He specially deplored the loss of the valuable help and advice of Sir Purshotamdas Thakurdas, who had identified himself with the work of the Committee almost from its inception, and expressed the hope that his absence from the Committee would be only temporary.

The Vice-President referred also to the following matters: Suggested new schemes of research; the policy of increasing the quantity of long staple cotton in India; the effect on prices of the entry of India as a serious competitor in the production of staple cotton; the question of publicity and propaganda; the amendment of the Berar Cotton and Grain Markets Law in Central Provinces; the working of the Cotton Transport Act and the Cotton Ginning and Pressing Factories Act; the reduction of fumigation fees for round or half-bale American cotton; the publication of statistics of Indian cotton consumed in Indian mills; the report of the Standing Finance Sub-Committee.

526. AHMEDABAD MILLOWNERS' ASSOCIATION. (*Text. Rec.*, xlix., 579, 1931, p. 76.) At the annual general meeting of the Association, the president, Sheth Chamanial, stated that prospects were brighter. Stocks have been cleared, and forward business secured. Looms and spindles both increased during the year, and better relations were continued with labour.

527. A Study of Causes contributing to the Large Variations in Yields from Year to Year of 4F Cotton in the Punjab. By T. Trought. (*Ind. Jnl. of Agr. Sci.*, i., 3, 1931, p. 309.) The established fact of large variations in yield from year to year of 4F cotton in the Punjab is due to "failure" in certain years. The symptoms of these failures are described, and their possible causes discussed. Diseases and pests may play a part, but are not initiating factors; they are a consequence of other factors. The effects of climatic and physiological factors are described, and the importance of root development emphasized. The deduction is drawn that in failure years the overlapping effect of a series of adverse factors operating at comparatively short intervals of time does not permit of the recovery of the plant before it matures its crop, and results in the failure of the plant to produce properly developed lint and seed. The plant is most susceptible in its early stages, at which time adverse factors are at their maximum. The factors react on root development, reducing it from its optimum. The adoption of good agricultural practice will assist in mitigating the effect of these adverse factors, but a complete solution can probably only be obtained by the discovery of a type of plant still more resistant to the severe climatic conditions which prevail.

528. Cotton in the United Provinces. (*Rpt. on Cotton Purchase Operations*, 1929-30 *and* 1930-31.) An account of the production and marketing of C. 402 cotton. The lint of this variety supplied from the 1930-31 crop is considered suitable for spinning 18's yarn, and on an average gives a test on 18's of approximately 70 lb. When used for spinning 21's the test obtained was rather low. The general consensus of opinion is that the C. 402 crop of 1930-31 is on a par with F. G. Broach April/May contract, and with one exception all mills hold the view that there should be extended planting of this variety in the United Provinces.

529. The Determination of Quality of Agricultural Produce, with Special Reference to Cotton. By A. J. Turner. (*Ind. Jour. of Agr. Sci.*, i., 2, 1931, p. 157.) Describes the work carried out at the Technological Laboratory, Bombay, with a view to predicting the highest standard warp counts for which a cotton is suitable, merely from an examination of the fibre-properties.

530. Spinning Test Reports on Indian Cottons. By N. Ahmad. (*Ind. Cent. Cot. Comm. Tech. Circs.*, Nos. 49-54.) The circulars contain the grader's report and spinning test results for Surat, Broach, Bailhongal, Cambodia, Hubli-Kumpta, Punjab-American, Jagadia Farm, Navsari, Karunganni, Karnool Cambodia, and Nandyal cottons for the 1930-31 season.

531. Indian Cotton Chart, 1930-31. We have received from Messrs. Chunilal Mehta and Company, Bombay, a copy of the cotton chart which has been published by them annually for the last six years immediately after the termination of the Broach contract for April-May delivery. This year's chart gives the April-May Broach quotations in Bombay and quotations for American in Liverpool and New York, and shows at a glance the parity relations between the two. A new addition has been made by the inclusion of silver quotations in view of the increased interest in silver, and the fact that the correlation between silver and commodity prices has been so much discussed.

COTTON IN THE EMPIRE (EXCLUDING INDIA).

532. The following reports have recently been received:

The Journal, 1931, South-Eastern Agricultural College, Wye.

British Guiana: Adm. Rpt. of Dir. of Agr., 1930.

Kenya Colony: Agr. Census, 1930.

NYASALAND: Ann. Rpt. of Dpt. of Agr., 1930.

NORTHERN RHODESIA: Ann. Rpt. of Dpt. of Agr., 1930.

SOUTHERN RHODESIA: Rpt. of Sec. Dpt. of Agr., 1930.

SUDAN: Ann. Rpt. of Dir. of Coml. Intell. Branch, Cent. Econ. Bd., 1930-31.
Rpt. of Govt. Chemist, 1930.

WEST INDIES: *Jamaica.* Ann. Rpt. of Dpt. of Agr., 1930.

533. BRITISH INDUSTRIES FAIR, 1932: TEXTILES SECTION. Very rapid progress has been made with the organization of the great display of British Textiles which is to be included in the British Industries Fair next February. Numerous branches of the industry have decided to group their exhibits for the convenience of buyers; impressive displays will be arranged in various branches of the textile trade, each of which in itself is an industry for which this country is famous. Irish Linen, Furnishing Fabrics, Scottish Woollens and Hosiery will each be represented in substantial groups, whilst the Silk, Artificial Silk, and Cotton sections have assumed such proportions that each will fill an entire hall. The wholesale trade is grouped in three magnificent halls. Leading firms are exhibiting cotton yarn and the finishing processes, and a movement among district associations of cotton spinners is assuming important dimensions which should lead to further substantial displays. Advance catalogues of the Fair will be despatched in time for textile buyers in far-off countries to have an opportunity of appreciating the extraordinary importance of next year's Fair, and to enable them to make arrangements in good time to come over to London.

534. EMPIRE COTTON: PRODUCTION. By J. A. Todd. (*Times Trade Eng. Suppl.*, May 23, 1931, p. 23. Abstr. from *Summ. of Curr. Lit.*, xi., **13**, 1931, p. 379.) An analysis of the economics of cotton production. The conclusion is drawn that Empire cottons have come through the ordeal of the past year better than any other cotton crops.

535. AFRICA: DÉVELOPPEMENT DE LA CULTURE DU COTON ET DES RECHERCHES COTONNIÈRES EN AFRIQUE. By W. J. Lugard. (*Exposition Colon. Internationale, Paris,* 1931.) The author has recently completed twenty months of study travel in Central Africa. He visited the Anglo-Egyptian Sudan, Uganda, the north of Belgian Congo, and the Colonies of Ubangi Chari and Tchad, and was thus able to learn something of the progress of cotton growing in those countries. The object of this paper is to show, in their broad outlines, the various problems to be solved, and the numerous points which must be taken into consideration. To assist the development of cotton growing in the countries visited the author suggests the establishment of meteorological stations; experiments to discover the most suitable varieties for the different districts; physiological research; study of insect pests and diseases and their control; adoption of a system of crop rotation; use of improved cultural implements; better cultivation, picking, and sorting methods; drying of the cotton before ginning.

536. NIGERIA. *Cotton Reports.* (*Bull. of Imp. Inst.*, xxix., **2**, July, 1931, p. 215). Mr. E. H. G. Smith, Botanist, Southern Nigeria, in a report covering the half-year ending December 31, 1930, gives the following summary of the results of an investigation, extending over two seasons, showing some of the effects of intercropping with yams upon the Ishan cotton plant.

"Due to intercropping, there is a basic or primary depression in growth of some 10 per cent. from which no recovery takes place. A retardation of growth occurs due to competition with the yams for the available soil moisture during the short dry season. This retardation increases rapidly during the break in the rains, to reach a maximum of 20 per cent. at the end of the period. Thereafter, a gradual recovery has been attained just before senescence occurs. In the first

investigation a minimum depression of 20 per cent. in the length of the monopodia was observed. As a result of the depression and retardation of growth, flower production, and hence boll production and yield, are reduced by from 25 to 35 per cent. The heavy flower-bud shedding, that normally occurs with indigenous cotton before the cessation of the rains, is reduced by intercropping, as the development of the intercropped plants is both depressed and retarded at this time. Intercropping increases the proportion of the crop borne by the sympodia, and decreases the proportion borne by the monopodia. Thus the losses of crop occasioned by intercropping occur from the monopodia alone. There is some evidence (during 1929-30 only) that intercropping slightly retards flowering and bolling. This retardation is of less than one week. There is evidence that intercropping slightly reduces the mean maximum lint length. This reduction is too small to be of economic importance. Intercropping does not affect shape of the plant (determined in 1928-29 only), boll shedding, mean boll weight, or period of maximum delivery of the crop. The data obtained from the study of ginning percentage is inconclusive. The competitive effect of the yam does not extend beyond a radius of 3 ft."

Mr. J. K. Mayo, Agricultural Botanist, Northern Provinces, reports that the main feature of the last six months has been jassid attack in October. This attack varied in intensity, but was worst at the Corporation's farm at Daudawa. Jassids have done no noticeable damage in previous years. The strain "D," which was selected for multiplication two years ago and is now found susceptible to jassid, is being withdrawn. Several other Allen strains and two of the introduced varieties, Acala and Mesowhite, were noticeably susceptible, and have been abandoned in the early (breeding plot) stages. There are two hairy strains, U4 and A12, supplied by Mr. Parnell in 1928, under trial. Commercial Allen, which is now a mixture of types, does not appear as a whole to be seriously affected by jassid, though individual plants suffered badly. Neither U4 nor A12 command any premium at home over the commercial lint. These varieties are being tested this season (1930-31) for yield against commercial seed, but the results are not yet available. In view, however, of the success of U4 in other parts of Africa, seed of two new strains derived from this strain has been obtained from the Corporation. There is only one really jassid-resistant strain ("C") among the Allen selections, and judging by the laboratory measurements and one broker's valuation on a roller-ginned sample (275 on) it should be a good one. Yield figures and the spinning test report are not yet available. There is, however, another Allen strain ("L") which, though not hairy or particularly resistant to jassid, has yielded well for two successive seasons, including this season of jassids, and has favourable brokers' and spinning reports.

Mr. F. D. Golding, Senior Entomologist, has furnished the following report on the final results of his cotton work at Bode Sadu which terminated in March, 1930. "In the report for the six months ending December 31, 1929, an account was given of the initial stages of a cotton survey carried out at Bode Sadu in the North of the Ilorin Province. The yields and pests of native cotton were compared with those of two types of Ishan A, multiplied at Ibadan and Ilorin respectively. The three cottons were grown on each of two 2½-acre blocks about 1,400 yards apart; Block A consisted of good soil typical of the district, and Block B of much poorer gravelly soil. Cotton stainers were not very numerous on either block, but the Pentatomid bug, *Halydicoris scoruba*, Dall., was responsible for much damage to all three cottons on Block B, being more prevalent on the Ishans than on the native. Bollworm attack was similar to that of other years. Jassid damaged native cotton in both blocks in December, but both Ishans were very little affected. The Capsid bug, *Helopeltis bergrothi*, Reut., was the principal pest on native farms in the vicinity of Bode Sadu, and was responsible for much

damage to the shoots of the cotton (especially Ibadan Ishan) in Block B. Cotton plants growing under unfavourable conditions appear to be more liable to attack by this insect than are healthy vigorous plants. Angular leaf spot and blackarm were prevalent in both blocks in October and November; and up to the middle of November about one-third of the bolls shed of all cottons on Block B bore bacterial lesions, while in Block A about 45 per cent. of each Ishan and 33 per cent. of the native were affected by this disease. The cleanliness of the Ishan seed cotton, which has also been observed in all surveys in the past, appears to be correlated with the greater tendency for boll shedding, or, in other words, many bolls which would have produced stained lint, had they persisted, are abscissed on account of the susceptibility of this cotton to damage to the green bolls. On Block A Ibadan Ishan gave a yield of greater value than the native, but this year's results confirm those of the two previous years—viz., that there is not sufficient evidence of the superiority of Ishan over native cotton in the Ilorin Province to warrant it replacing the indigenous variety. The conditions in that province appear to be unfavourable to Ishan, which has been derived from a cotton grown in the Benin Province."

[*Cf.* Abstr. **442**, Vol. VII., of this Review.]

537. NYASALAND. *Cotton Cultivation*, 1930. (*Ann. Rpt. of Dpt. of Agr.*, 1930.) From the report of the Director of Agriculture we learn that the season was a good one for cotton, the native production of seed cotton amounting to 5,448 tons, compared with 3,505 tons in 1929, and in addition a larger proportion of the crop was first grade cotton. As in recent years, most of the crop was purchased by the British Cotton Growing Association, a total amount of £14,624 being disbursed to the growers.

In connection with the work of the Corporation in Nyasaland, the Director of Agriculture writes as follows: " Much of the credit for the size and excellence of the 1930 crop of cotton was due to the experimental work and planting date propaganda of the Cotton Specialist of the Empire Cotton Growing Corporation, and also to the success of Over-the-Top seed in up-country areas. It has already been noted that U4 cotton promises so well that plans are in hand to put it into general distribution in 1933.

" The experimental work of the Corporation was continued on the Makwapala and Port Herald Stations, and good progress was made with the development of the new Domira Bay Station on which cotton-breeding work will be centralized, and on which variety, time of planting, and spacing trials will be carried out along with observations on the behaviour of various strains. Rotations with food crops will also form part of the work.

" At Makwapala special attention has been given to the improvement of laterized soil through the use of implements to obtain deeper ploughing and better tilth, farmyard manuring, and the growing of deep-rooting legumes which penetrate the pan. A soil survey showed that the depth of soil above the pan was such as to cause cotton to behave as a shallow-rooted crop, and to become liable to suffer from drought, and therefore pointed to the practical and useful nature of the work referred to. Useful rotational work has been done, and soil erosion has been satisfactorily controlled by ridge terraces. Special attention has been given to the relationships of cotton and tobacco, both of which are important as native cash crops. Spacing experiments with U4 showed that there was a progressive increase of yield with increase of plant density, and that the denser spacings gave an earlier and heavier first picking. These results are of practical value.

" At the Port Herald Station the cotton area was increased to 30 acres. Work was concentrated on U4 and a Cambodia strain, and trials were continued and combined with time of planting and spacing experiments. The latter gave

results which indicated that yield was greatly influenced by plant density, and the experiments will be repeated. Earlier work has pronounced in favour of early planting after the first main rains. Cotton-breeding work was continued, and a number of strains have been provided for jassid and drought tests under Domira Bay conditions."

538. NORTHERN RHODESIA. *Cotton Cultivation.* (*Ann. Rpt. of Dpt. of Agr.*, 1930.) The major part of the investigational work of the Central Research Station, Mazabuka, was again concentrated on the phytopathological problems of cotton growing, since on the partial solution of such problems the establishment of cotton as a commercial crop depends. Jassid was not a limiting factor during the season, but much damage was caused by bollworms and insects causing internal boll-rot.

In the report of the East Luangwa Province it is stated that cotton has been cultivated by the natives in the Luangwa Valley for a very considerable period. The species grown is *Gossypium brasiliense*. The natives spin yarn, employing a most primitive type of spindle consisting of a hook on the top of a hard nut taken from a palm tree, the whole being mounted on a stick 10 in. long. Until recently they manufactured their own cloth from this cotton, the material being most durable and of excellent quality. The measurable characters of the lint were: Mean length 29·3 mm., mode 31 mm., and hair weight per centimetre 262.

Recent experiments with U.4 cotton in the Fort Jameson area yielded results of a distinctly encouraging nature, and further experiments may prove cotton to be a valuable crop in rotation with tobacco.

539. SOUTHERN RHODESIA. *Cotton Cultivation*, 1929-30. (*Rpt. of Sec. Dpt. of Agr.*, 1930.) The season opened moderately well for cotton, but the crop was checked by the dry spells which occurred in January and February. A large amount of the cotton was, therefore, delayed in maturing, with the result that a considerable proportion of the crop suffered from American bollworm injury. In spite of this fact, however, there were a number of exceptionally good crops throughout the country. The average yield per acre leaves much to be desired, although it shows a decided advance on previous years, with the exception of the 1923-24 season.

Formerly a certain amount of difficulty was encountered in Southern Rhodesia in marketing the crop, and in order to provide an additional outlet the services were enlisted of the Central Co-operative Cotton Exchange, Ltd., Durban, an organization consisting of a federation of co-operative ginneries in the Union of South Africa, the two Rhodesias, and Swaziland. The three co-operative ginneries in Southern Rhodesia are affiliated to the Central Co-operative Cotton Exchange, and it is satisfactory to record that, despite the low prices which now rule for cotton, the whole output of the two co-operative ginneries in this country was handled by them and every bale sold. This has enabled prompt settlement of accounts—a very welcome feature in view of the very difficult selling conditions which prevailed last season.

540. *Cotton Cultivation*, 1929-30. By G. S. Cameron. (*Rpt. of Sec. Dept. of Agr.*, 1930.) From the report of the Cotton Specialist we learn that sufficient seed was issued to plant 10,000 acres had growers used the seed rate recommended of 10 lb. per acre; the actual area planted, however, was about 7,000 acres. The average yield per acre was 289 lb., which did not appear very satisfactory at first sight, but compared with previous seasons (except 1923-24) it was a big stride forward. The anticipated yield of 300 lb. per acre was not realized owing chiefly to the following reasons: Attacks of American bollworm; drought in January; insufficient supply of seed, which resulted in poor stands being obtained generally throughout the country; miscellaneous causes, such as late planting, insuffi-

cient cultivation, and in some cases neglect of the crop. Mr. Cameron states that in future years there will be no necessity to economize seed for planting, since the supply now available is amply sufficient to meet the demand, and the necessity for using a heavy seed rate for planting has been stressed whenever possible.

During the year re-selections from U.4 cotton were issued to growers in 10 lb. packets for the purpose of bulking up seed in special plots, and it is satisfactory to record that this scheme of seed improvement has met with the general approval of cotton growers throughout the Colony.

Three ginneries were in operation throughout the season, at Salisbury, Bindura, and Gatooma; the latter two are affiliated to the Central Co-operative Cotton Exchange, Ltd., Durban. Mr. T. Hesse, manager of the Cotton Exchange, toured the cotton-growing areas and gave some addresses to the cotton growers which were very much appreciated. Mr. J. Z. Boshoff was appointed Seed Cotton Classifier in April, 1930, and a marked improvement was soon noticeable in methods of sampling; this has given much satisfaction, and is said to have facilitated sales.

At the Cotton Breeding Station, Gatooma, the work suffered for the second season in succession from very severe attacks of American bollworm. One effect of the bollworm attack was to demonstrate clearly how payable yields can be obtained by the combination of planting more prolific strains and adopting the practice of closer spacing in the row. Officers of the Empire Cotton Growing Corporation are endeavouring to control the bollworm pest by means of trap cropping, hand collecting, and by the release of an egg parasite (*Trichogramma lutia*, Gir.).

Mr. Arthur Foster, Vice-Chairman, and Sir James Currie, Director of the Corporation, visited Southern Rhodesia during May and June, and satisfaction was expressed at the progress of the cotton-growing industry since the previous visit of the Director. Dr. Harland, geneticist at the Corporation's Cotton Research Station, Trinidad, also visited the Colony during the year.

Prospects for the Current Season.—Mr. Cameron reports that, notwithstanding the low prices ruling, growers have demonstrated an increased confidence in cotton by planting a much larger acreage this year. He concludes as follows: "If their confidence is justified—and there is considerable evidence to show that it is—there appears every reason to hope for a continuous gradual increase in the cotton-growing industry. If this takes place at a rate commensurate with the release and multiplication of better yielding strains from the Cotton Breeding Station, coupled with increased knowledge of better cultural methods, we may justly look forward to the future with confidence."

541. *Biology and Cotton Growing.* By J. E. Peat. (*Proc. of the Rhod. Sci. Asscn.*, xxx., 1930-31, p. 25.) A very informative account of the work in connection with cotton breeding and selection, rotation of crops, and control of pests that is being carried out at the Cotton Station, Gatooma, Southern Rhodesia, with a view to establishing on a sound foundation a cotton-growing industry in the country. The wide range of study necessary in connection with the work is indicated by the author in the following words: "We are attempting to introduce a new crop into a new country, a plant type into a new environment. We know the environments in which this plant type is already growing and fruiting sufficiently well to give an economic return. Our first interest is the study of the particular range of our own environmental conditions, our soils, our temperatures, the distribution of our rains, our sunshine, our pests, and then, as a start, the introduction of plant types from environments somewhat similar. We have to plant out as wide a range of cottons as can be got together, especially from environments most similar to Rhodesia—with us American types. Now, it is essential to watch closely the behaviour of these plant types, and strains selected from them,

in relation to their new environment, and to make a close observation of what is happening, considering not only the final yield at harvest-time, but following the life of the plant throughout the season, observing the effect of the environmental conditions on the types, the effect of the rainfall distribution, of drought, temperature and pests; it is necessary to make an attempt at the analysis of the factors contributing to the final expression of yield, and an attempt to discover the exact nature of the unfavourable environmental factors as a first step to their modification or control."

The author states that the most successful strain of cotton evolved up to the present is U.4/64/7 (derived from the Barberton variety U.4), which has proved markedly resistant to bollworm. This is the most serious pest of cotton in Southern Rhodesia, and on the success of the control measures against it will depend to a great extent the importance of cotton in the country.

542. *Southern Rhodesian Crops in* 1930-31. (*Cape Argus*, Cape Town, May 29, 1931.) The preliminary estimates of crops for 1930-31 show the extent to which maize has given way to cotton, tobacco, and groundnuts, and the greatly increased acreage put to green manure. It is estimated that the lint yield of the cotton crop for 1930-31 will be 933,000 lb. as against 600,000 lb. in 1929-30.

543. SOUTH AFRICA. *Cotton Progress and Prospects.* (*Sun and Agr. Jour. of S.A.*, March, 1931, p. 214.) In an interview given to the *Sun and Agr. Jour. of S.A.*, Mr. R. Ingram, Director and Manager of the Cotton and Tobacco Exporting Company, Germiston, deals with cotton prices and the American crop, and advances the encouraging opinion that prices for this world commodity will recover at no distant date. He also shows the marked improvement that has been made in the development of better lint in South Africa during the past ten years, and emphasizes the fact that cotton growing has come to stay in that country, and will continue to afford an attractive and profitable crop for the enterprising and hard-working farmer. Incidentally the remark is made that, in 1922, 60 per cent. of the cotton received was of $1\frac{1}{16}$ staple, while last year this fell to 8 per cent., the balance being made up of longer cotton.

544. SUDAN. *Cotton Cultivation*, 1929-30. (*Ann. Rpt. of Cent. Econ. Board*, 1930-31.) In the Gezira Irrigation Scheme there was a considerable decrease in the crop during 1929-30, which may be attributed to exceptionally heavy rainfall, which retarded sowing operations and caused a late crop with a poor stand; to ravages of diseases, particularly blackarm and leaf crinkle; and to a universally cold period from December to February. The area under cotton in the present season is 196,023 acres, as against 174,133 acres in 1929-30. The area of the Kassala Cotton Company was under cotton for the first time in 1929-30, and gave a yield of approximately $4\frac{1}{2}$ kantars per feddan.

The Gezira Research Farm continued its work in connection with cotton problems. The farm was extended by taking in 212 feddans on the north side, making a total area of 646 feddans available for field plots. The heavy rainfall in 1929 resulted in considerable flooding, and the resulting water-logging adversely affected the ensuing crops on the farm, consequently results from experiments are less significant than in previous years. Drains have since been cut to cope with surplus surface water, and conditions were greatly improved during the 1930 rains.

The Sudan Plantations Syndicate had a most successful year at Zeidab; from an area of 5,522 feddans 18,609 kantars of cotton were produced, which constituted a record yield.

In the southern area, cultivation of American cotton under rainfall made satisfactory progress, especially in Kordofan and in Mongalla Provinces.

545. *Cotton Prospects.* (*Monthly Rpt. of Comm. Intell. Branch,* June, 1931.) The latest reports are to the effect that in the Gash Delta the total yield of cotton is expected to be 56,000 kantars. In Tokar Delta the estimated crop is 69,840 kantars. Leaf curl has abated, and some of the affected areas have partially recovered. A sea-bank, some 14 miles in length, has been completed, which will not only prevent the flood from getting into the sea, but will also form a deposit of silt on which cotton will be grown in the future. In the Upper Nile Province the promise of cotton seed proved very popular, and most villages have asked for an increased allotment, in spite of the present low prices. In the Latuka district, Mongalla Province, the industry is becoming established and seed is being issued, and there is also a big demand for seed from the Eastern Jebels district, Kordofan Province.

546. TANGANYIKA TERRITORY. *Cotton Prospects.* The latest report received is to the effect that cotton prospects in most areas are satisfactory. Extensive areas have been planted to cotton in the Rufiji district.

547. AGRICULTURAL RESEARCH CONFERENCE HELD AT AMANI RESEARCH STATION, FEBRUARY, 1931. We have received a copy of the Proceedings of the Conference, which was convened by the Secretary of State to discuss the investigational and research work undertaken or proposed in each of the East African Territories and at Amani. Among the matters discussed at the Conference were the following: Programme of work at Amani and the various Directorates of Agriculture; Dissemination of information ; Development of economic enquiries and of marketing and co-operative organization ; Organization of service for development of native agriculture ; Soil questions ; Programme of work for crop improvement, including cereals, cotton, coffee, sisal, tobacco, etc. ; Questions affecting staff of agricultural departments of East Africa.

548. UGANDA. *Cotton Cultivation.* A recent report from the Department of Agriculture states that owing to the large amount of time that was spent during March and April by natives in locust destruction and planting of food crops, the work of clearing land for cotton had been somewhat retarded in several districts. Efforts were being made, however, to get as much cotton as possible planted during June and July, and it was not anticipated that there would be any appreciable decrease in acreage during the coming season.

549. AUSTRALASIA: QUEENSLAND. *The Cotton Industry.* (*Queens. Agr. Jour.*, xxxv., 6, 1931, p. 410.) A report of a meeting between members of the Queensland Cotton Board and the Minister for Agriculture, at which the following, among other matters relevant to the cotton industry, were discussed: Importation of Cotton Seed; The Government Guarantee; Cotton Varieties.

550. WEST INDIES. COTTON REPORTS. (*Trop. Agriculture,* viii., 7, 1931, p. 189.) MONTSERRAT.—The planters have loyally co-operated with the Agricultural Department in an attempt to improve still further the quality of Montserrat cotton. Following on the advice of Dr. Harland, the Government, at the request of the cotton growers, recently introduced an ordinance to control the quality of the seed supply of the island. It is now illegal to sow cotton seed which has not previously been certified by the Agricultural Department as coming up to a certain specified standard.

ST. VINCENT.—A satisfactory crop has been reaped from the 4,000 acres planted to cotton. The crop is purchased by the Government at the ginnery, and is shipped on behalf of the peasants. The initial payment this year was 2½d. per lb. of seed cotton. There are over 1,500 peasants growing cotton, and they cultivate between them some 1,700 acres.

in relation to their new environment, and to make a close observation of what is happening, considering not only the final yield at harvest-time, but following the life of the plant throughout the season, observing the effect of the environmental conditions on the types, the effect of the rainfall distribution, of drought, temperature and pests; it is necessary to make an attempt at the analysis of the factors contributing to the final expression of yield, and an attempt to discover the exact nature of the unfavourable environmental factors as a first step to their modification or control."

The author states that the most successful strain of cotton evolved up to the present is U.4/64/7 (derived from the Barberton variety U.4), which has proved markedly resistant to bollworm. This is the most serious pest of cotton in Southern Rhodesia, and on the success of the control measures against it will depend to a great extent the importance of cotton in the country.

542. *Southern Rhodesian Crops in* 1930-31. (*Cape Argus*, Cape Town, May 29, 1931.) The preliminary estimates of crops for 1930-31 show the extent to which maize has given way to cotton, tobacco, and groundnuts, and the greatly increased acreage put to green manure. It is estimated that the lint yield of the cotton crop for 1930-31 will be 933,000 lb. as against 600,000 lb. in 1929-30.

543. South Africa. *Cotton Progress and Prospects.* (*Sun and Agr. Jour. of S.A.*, March, 1931, p. 214.) In an interview given to the *Sun and Agr. Jour. of S.A.*, Mr. R. Ingram, Director and Manager of the Cotton and Tobacco Exporting Company, Germiston, deals with cotton prices and the American crop, and advances the encouraging opinion that prices for this world commodity will recover at no distant date. He also shows the marked improvement that has been made in the development of better lint in South Africa during the past ten years, and emphasizes the fact that cotton growing has come to stay in that country, and will continue to afford an attractive and profitable crop for the enterprising and hard-working farmer. Incidentally the remark is made that, in 1922, 60 per cent. of the cotton received was of $1\frac{1}{16}$ staple, while last year this fell to 8 per cent., the balance being made up of longer cotton.

544. Sudan. *Cotton Cultivation*, 1929-30. (*Ann. Rpt. of Cent. Econ. Board*, 1930-31.) In the Gezira Irrigation Scheme there was a considerable decrease in the crop during 1929-30, which may be attributed to exceptionally heavy rainfall, which retarded sowing operations and caused a late crop with a poor stand; to ravages of diseases, particularly blackarm and leaf crinkle; and to a universally cold period from December to February. The area under cotton in the present season is 196,023 acres, as against 174,133 acres in 1929-30. The area of the Kassala Cotton Company was under cotton for the first time in 1929-30, and gave a yield of approximately 4½ kantars per feddan.

The Gezira Research Farm continued its work in connection with cotton problems. The farm was extended by taking in 212 feddans on the north side, making a total area of 646 feddans available for field plots. The heavy rainfall in 1929 resulted in considerable flooding, and the resulting water-logging adversely affected the ensuing crops on the farm, consequently results from experiments are less significant than in previous years. Drains have since been cut to cope with surplus surface water, and conditions were greatly improved during the 1930 rains.

The Sudan Plantations Syndicate had a most successful year at Zeidab; from an area of 5,522 feddans 18,609 kantars of cotton were produced, which constituted a record yield.

In the southern area, cultivation of American cotton under rainfall made satisfactory progress, especially in Kordofan and in Mongalla Provinces.

545. *Cotton Prospects.* (*Monthly Rpt. of Comm. Intell. Branch,* June, 1931.) The latest reports are to the effect that in the Gash Delta the total yield of cotton is expected to be 56,000 kantars. In Tokar Delta the estimated crop is 69,840 kantars. Leaf curl has abated, and some of the affected areas have partially recovered. A sea-bank, some 14 miles in length, has been completed, which will not only prevent the flood from getting into the sea, but will also form a deposit of silt on which cotton will be grown in the future. In the Upper Nile Province the promise of cotton seed proved very popular, and most villages have asked for an increased allotment, in spite of the present low prices. In the Latuka district, Mongalla Province, the industry is becoming established and seed is being issued, and there is also a big demand for seed from the Eastern Jebels district, Kordofan Province.

546. TANGANYIKA TERRITORY. *Cotton Prospects.* The latest report received is to the effect that cotton prospects in most areas are satisfactory. Extensive areas have been planted to cotton in the Rufiji district.

547. AGRICULTURAL RESEARCH CONFERENCE HELD AT AMANI RESEARCH STATION, FEBRUARY, 1931. We have received a copy of the Proceedings of the Conference, which was convened by the Secretary of State to discuss the investigational and research work undertaken or proposed in each of the East African Territories and at Amani. Among the matters discussed at the Conference were the following: Programme of work at Amani and the various Directorates of Agriculture; Dissemination of information ; Development of economic enquiries and of marketing and co-operative organization ; Organization of service for development of native agriculture ; Soil questions ; Programme of work for crop improvement, including cereals, cotton, coffee, sisal, tobacco, etc. ; Questions affecting staff of agricultural departments of East Africa.

548. UGANDA. *Cotton Cultivation.* A recent report from the Department of Agriculture states that owing to the large amount of time that was spent during March and April by natives in locust destruction and planting of food crops, the work of clearing land for cotton had been somewhat retarded in several districts. Efforts were being made, however, to get as much cotton as possible planted during June and July, and it was not anticipated that there would be any appreciable decrease in acreage during the coming season.

549. AUSTRALASIA: QUEENSLAND. *The Cotton Industry.* (*Queens. Agr. Jour.*, xxxv., 6, 1931, p. 410.) A report of a meeting between members of the Queensland Cotton Board and the Minister for Agriculture, at which the following, among other matters relevant to the cotton industry, were discussed: Importation of Cotton Seed; The Government Guarantee; Cotton Varieties.

550. WEST INDIES. COTTON REPORTS. (*Trop. Agriculture,* viii., 7, 1931, p. 189.) MONTSERRAT.—The planters have loyally co-operated with the Agricultural Department in an attempt to improve still further the quality of Montserrat cotton. Following on the advice of Dr. Harland, the Government, at the request of the cotton growers, recently introduced an ordinance to control the quality of the seed supply of the island. It is now illegal to sow cotton seed which has not previously been certified by the Agricultural Department as coming up to a certain specified standard.

ST. VINCENT.—A satisfactory crop has been reaped from the 4,000 acres planted to cotton. The crop is purchased by the Government at the ginnery, and is shipped on behalf of the peasants. The initial payment this year was 2½d. per lb. of seed cotton. There are over 1,500 peasants growing cotton, and they cultivate between them some 1,700 acres.

COTTON IN EGYPT.

551. Egypt. *Cotton Cultivation.* (*Int. Rev. of Agr.*, xxii., 7, July, 1931, p. 396.) It is estimated that the area planted to cotton this year is 7 to 13 per cent. smaller than that of last year (2,161,700 acres). The Government's policy tends to confine the cultivation of Sakellaridis to those areas of the northern Delta most suited for it, reducing the area in order to restrict production to the present state of the demand. There is no restriction, however, to the cultivation of other varieties, of which some high grades are in full course of expansion. Weather conditions have been fairly favourable, but attacks of leaf worm have been severe, especially in the Delta.

552. The Royal Agricultural Society of Egypt. By A. Reid. (*Afr. World*, Egypt and Sudan Annual, 1931, p. 47.) Gives the history, organization, administration, and objects of the Society, which was founded in 1897, and describes the work of the Animal Breeding Section and Technical Section. An interesting account is also included of the work done in connection with "Maarad" cotton, of which some 70,000 acres were under cultivation in 1930. It is stated that both growers and spinners are favourably disposed towards this new cotton, and when the price becomes more or less fixed, perhaps at a slightly less premium than Sakel, it will meet the requirements of both cultivator and spinner, and be of benefit to all concerned.

COTTON IN THE UNITED STATES.

553. American Textile Notes. By W. Whittam. (*Text. Rec.*, xlix., **579**, 1931, p. 79.) It is stated that there are approximately 2,000,000 farmers growing cotton in ten of the Southern States, and not one grower in one hundred thousand can grade and staple his cotton, although these determine its value.

In this connection the Senior Cotton Technologist of the U.S. Dept. of Agriculture has under way in his division a programme of work for the purpose of determining scientifically what is meant by quality in cotton. It is hoped to isolate and measure with precise methods each measurable characteristic and property of the fibres, and to evaluate them mathematically in terms of spinning behaviour and yarn or fabric properties.

554. American Cotton Mills: Development. By C. L. Emerson. (*Mech. Eng.*, **53**, 1931, p. 339. Abstr. from *Summ. of Curr. Lit.*, xi., **13**, 1931, p. 368.) A review of past progress and future possibilities in the American cotton industry, dealing more particularly with the housing of employees, building design, humidity and heat control, illumination, machinery speed control, the labour problem, and research.

555. Cotton Mills: Construction and Equipment. (*Text. World*, **79**, 1931, p. 641. Abstr. from *J. of Text. Inst.*, xxii., **6**, 1931, A320.) A review of American developments in textile mill construction, power supplies, and heating, ventilating, and conditioning equipment, presenting the opinions of experienced engineers.

556. Cotton Cost Factors that Count. By G. W. Fooshe. (*Man. Guar. Coml.*, July 16, 1931, p. 49.) A more than usually interesting discussion of the tangible and intangible factors entering into the cost of producing cotton in the United States. These factors are, weather and soil, costs of land preparation, seed, planting, cultivation, fertilizers, land rental, harvesting, ginning and marketing, labour and equipment. Two tables are included, (1) showing the cost of producing cotton by yield groups in 1929 (the latest data from the Dept. of Agriculture), and (2) showing, for the first six months of 1929 and 1930, and five months of 1931, the index of farmers' living expenses and production costs;

the price of middling spot cotton at New Orleans; the all-commodity index of the U.S. Dept. of Labour; the ratio of spot cotton to the all-commodity index; the ratio of spot cotton to the index of farmers' living expenses and production costs.

557. LONG STAPLE COTTON: CULTIVATION. By O. F. Cook. (*U.S. Dpt. of Agr., Reprint No.* 1134. From *Year Book of Agr.*, 1930. Abstr. from *Summ. of Curr. Lit.*, xi., **9**, 1931, p. 223.) A greatly increased production of long-staple cottons is possible and necessary in the United States. Recent statistics indicate that 79 per cent. of the crop of American Upland cotton in 1928 was under 1 in. in length, whilst less than 5 per cent. attained $1\frac{1}{8}$ in., and less than 1 per cent. was $1\frac{1}{4}$ in. Nearly 18 per cent. was not tenderable in the futures market because the fibre was less than $\frac{7}{8}$ in. in length. Disregard of quality has thus been carried to an extreme, and the fibre in many districts has declined to a footing of competition with the shortest and cheapest cottons from India and China. The best outlook for developing a sustained and successful production of long-staple cotton seems to be in organized progressive communities where marketing as well as production improvements can be applied.

558. SEA ISLAND COTTON. (*Text. Rec.*, xlix., **578**, 1931, p. 77.) Looking to the possible re-establishment of Sea Island cotton in the south-eastern States, three specialists of the United States Bureau of Plant Industry have gone to Porto Rico to study improved methods of handling this long-stapled variety. Later, they will make similar studies in several of the British West Indian islands. It will be recalled that the boll weevil wiped out this variety in the United States some years ago.

559. CALIFORNIA. *Cotton Prospects.* (*S. Calif. Crops.*, vii., **5**, 1931, p. 9.) Cotton prospects are excellent as far as yield is concerned, but the price outlook is not favourable. Field conditions indicate a record yield in the San Joaquin Valley.

560. GEORGIA: *Cotton Fertilizer Experiments*, 1930. *Sources of Nitrogen, Supplements, and Time and Method of Application.* By G. A. Hale. (*Ga. Sta. Circ.*, **91**, 1930. Abstr. from *Exp. Sta. Rec.*, lxiv., **6**, 1931, p. 534.) In complete fertilizers for cotton the phosphorus in ordinary 16 per cent. superphosphate and in 43 per cent. or triple superphosphate was more efficient than that in diammonium and monoammonium phosphate. Magnesian limestone (400 lb.) increased yields on all plats. Small applications, 100 to 400 lb. of magnesian limestone used with ammonium sulphate 150 lb. in a complete fertilizer, gave profitable increases. Both magnesium sulphate and calcium carbonate (calcic limestone) increased cotton yields when added to a concentrated complete fertilizer. Although peanut and velvet bean meal led the older nitrogen carriers in acre yield, calcium nitrate was a more desirable single source, because of lower cost per pound of nitrogen. Of the new carriers those materials containing a combination of calcium and nitrate nitrogen produced the most cotton. Small quantities of cotton-seed meal used with sodium nitrate made more cotton than where only sodium nitrate was used.

In tests of time and method of applying nitrogen, ammonium sulphate gave best results in a divided application, and a mixture of sodium nitrate and ammonium sulphate was better than either used alone. The response to potassium on Cecil clay loam was slight, but top-dressing seemed to be somewhat superior to putting all the potassium under the cotton. With complete fertilizer the results indicated that split applications, where large quantities are used, gave greater returns than putting all the plant food under the cotton. Barring off the cotton at chopping to make side applications of fertilizer by hand seemed to reduce yields.

561. *Cotton Variety Tests*, 1930. By H. K. Brabham and G. A. Hale. (*Ga. Sta. Circ.*, **90**, 1930. Abstr. from *Exp. Sta. Rec.*, lxiv., **6**, 1931, p. 533.) Variety tests with cotton at the station and near Yatesville in the Piedmont and near Waynesboro and Carnegie in the Coastal Plain section are reported for 1930. Among the cottons of merit for wilt-free soils were Stoneville No. 2, Coker Cleveland 884, and D. and P.L. No. 8, and for wilt-infected soil Lightning Express and Super Seven.

562. MISSISSIPPI. *Agronomic Work in* 1929. By J. F. O'Kelly *et al.* (*Miss. Sta. Rpt.*, 1929. Abstr. from *Exp. Sta. Rec.*, lxiv., **5**, 1931, p. 432.) In fertilizer tests with cotton under farm conditions, profitable yield increases came from the use of both phosphorus and nitrogen on prairie soils—*e.g.*, 600 lb. of an 8-8-0 formula. On sandier soils yields were decidedly increased by using the same quantity of 8-6-4 fertilizer. It appeared that mixed fertilizers should contain a high proportion of nitrogen.

563. *Cotton Variety Summary*, 1926-30. By J. F. O'Kelly and W. W. Hull. (*Miss. Sta. Bull.* 288, 1930. Abstr. from *Exp. Sta. Rec.*, lxv., **1**, 1931, p. 34.) Among the leaders in average acre yields of lint were Cleveland 54, D. and P.L. Nos. 4-8 and 6, Half and Half, Delfos, Lone Star, and Wilson Type. Yields and other agronomic data are shown for varieties tested in 1930 at the station. Comparisons showed Red Leaf cotton to yield less than Cleveland 54 or Miller 589; it is also objectionable in communities producing pure seed for sale.

564. NORTH CAROLINA. *Cotton Variety, Breeding and Cultural Experiments, including Technical Cotton Fibre Investigations.* By C. B. Williams. (*Fifty-Third Ann. Rpt. Agr. Exp. Sta. N. Carolina*, 1930.) The inheritance of the smooth, fuzzy-tip, and fuzzy characters of cotton seed have been studied, strains, self-pollinated for several generations, and homozygous for these characters, being used in making crosses. The results show that smooth is dominant to all types of fuzz; the fuzzy-tip character is dominant to complete fuzziness, but is recessive to the entirely smooth condition.

Results of the variety experiments conducted during the past three years show that the highest yielding varieties producing a staple length of 1 to $1\frac{1}{16}$ in. are the Mexican strains, Cleveland 884, 5 and 20-3. The Wanamaker-Cleveland "Standard" was the heaviest yielder in the short staple group.

In connection with cotton fibre investigations, studies are being made of the following: Fibre diameter or "fineness"; uniformity and length of staple from pure strains of Mexican cotton; the relation of drag and other fibre properties to yarn quality; the effect of different combinations and amounts of fertilizing constituents upon the physical properties of fibre from cotton grown on different soil types.

565. *Results of Cotton Variety Experiments for* 1927-30 *and Production and Consumption of Different Staple Lengths.* By P. H. Kime and S. J. Kirby. (*N. Car. Sta. Agr. Inf. Circ.* 57, 1931. Abstr. from *Exp. Sta. Rec.*, lxiv., **9**, 1931, p. 832.) Certain strains of Mexican and Cleveland cotton are suggested for the light to medium-heavy soils, the Fosters strains for heavy and poorly drained soils, and Dixie and Dixie Triumph for wilt-infested soils. The quantity of 1 to $1\frac{1}{8}$ in. cotton consumed by mills in the South-eastern States far exceeds the production in this region, while the domestic demand for short cotton of $\frac{7}{8}$ in. and under is very limited.

[*Cf.* Abstr. **51**, p. 55, Vol. VIII., of this Review.]

566. *Suggested Plan for Improving the Quality of Cotton in North Carolina.* By R. Y. Winters. (*N. Car. Sta. Agr. Inform. Circ.* 59, 1931. Abstr. from *Exp. Sta. Rec.*, lxiv., **9**, 1931, p. 832.) Provides for division of the State into three regions according to soil and climate; for one-variety regions based

upon market demands and adaptation of cotton varieties, and for adequate seed supply to maintain the quality and uniformity of staple length.

567. OKLAHOMA. *Field Crops Research*, 1926-30. By H. J. Harper *et al.* (*Oklahoma Sta. Rpt.*, 1927-30. Abstr. from *Exp. Sta. Rec.*, lxiv., 8, 1931, p. 732.) *Cotton experiments.* Oklahoma Triumph 44 varied in breaking strength per square inch of cotton cellulose from 30,100 lb. for lint from poor land to 40,650 lb. from medium land, and 58,100 lb. from good land. Fibre from fertilizer tests did not show conclusive evidence of quality improvement over checks. Cotton treated with moisture (65 per cent. relative humidity for twelve hours) broke from 2,000 to 3,000 lb. stronger than bone-dry cotton. Five bales of cotton picked in its prime graded strict middling with a $\frac{3}{16}$ in. staple and averaged 81,506 lb. breaking strength, whereas five bales grown under like conditions, but picked after several weeks of rain, and graded strict low middling with the same staple, broke at 77,296 lb.

568. *Size of Plat and Number of Replications in Field Experiments with Cotton.* By L. L. Ligon. (*J. Amer. Soc. Agr.*, xxii., 8, 1930, p. 689. Abstr. from *Exp. Sta. Rec.*, lxiv., 6, 1931, p. 533.) Field studies to determine the minimum size of plat and number of replications consistent with accuracy for cotton experiments were made in cultural and varietal trials in progress at the Oklahoma Experiment Station during 1925, 1926, and 1927. Statistical treatment of the yield data from the various groupings by the several sizes of plats suggested that in cotton-field tests where yield is a factor for consideration the rows need not be longer than 100 ft. It appeared possible that shorter rows with an increase in the number of replications might be even more desirable. A three-row plat in which the central row only is used for yield data might serve as well as plats with more rows. Plats of single rows 100 ft. long gave a probable error of 6·05 per cent. for one replication in 1925, and probable errors of 6·37 per cent. and 5·61 per cent. for two replications in 1926 and 1927 respectively. The use of three replications, or four plats, of each variety is suggested. The merits of the 200-ft. and 300-ft. plats are also pointed out.

569. SOUTH CAROLINA. *Cotton Research.* (*S. Car. Sta. Rpt.*, 1930. Abstr. from *Exp. Sta. Rec.*, lxiv., 7, 1931, p. 628.) Describes varietal, cultural, fertilizer, and cover crop tests; physiological and fibre studies; and seed treatments.

COTTON IN FOREIGN COUNTRIES.

570. INTRODUCTION DU COTON CHEZ L'INDIGÈNE. By U. Blommaert. (*Coton et Cult. Cotonn.*, v., 3, 1930, p. 224.) Experiments were made in Maniema (Belgian Congo) to find the best variety for native use, keeping in mind the needs of Belgian spinners, and Triumph was finally chosen, the seed cotton being afterwards bought from the growers, who were instructed and supervised by travelling agronomists. All seed was supplied by Government and disinfected.

571. CHINESE COTTON GOODS IMPORTS: STATISTICS. (*Text. Weekly*, 7, 1931, p. 40. Abstr. from *Summ. of Curr. Lit.*, xi., 10, 1931, p. 290.) Comparative figures are given of imports of British and Japanese goods for 1927, 1928, and 1929. Quantities are tabulated for thirty-two types of piece goods.

572. COTTON CULTIVATION IN COLOMBIA. By R. Herrán. (*Leipz. Woch. Textil-Ind.*, 1931, 46, 274. Abstr. from *Summ. of Curr. Lit.*, xi., 13, 1931, p. 352.) Colombian cotton has a staple length varying between 27 and 33 mm., according to the district in which it is grown. The best types are obtained from La Goajira, Remolino, and Antioquia. A wild plant known as Pajarito is found in some districts; it gives a short, soft, white, and lustrous fibre, and is free from the diseases that attack the cultivated plants. The type generally cultivated is very

similar and is grown chiefly in Boyaca and Santander. Lengupa yields a fibre 28 mm. in length, and is grown to a large extent in Santander. Caqueta and Mono are also grown. The annual production is estimated at 8 million kg. During the past year 125,200 kg. were exported, although considerable quantities of cotton are imported to meet the needs of the domestic cotton industry.

573. THE TREND OF THE GERMAN TEXTILE INDUSTRY. By Dr. A. Niemeyer. (*Text. Rec.*, xlix., **579**, 1931, p. 39.) Discusses the present position in regard to the cotton, woollen, linen, and silk and rayon industries of Germany.

574. REPORT OF THE GERMAN RESEARCH INSTITUTE FOR THE TEXTILE INDUSTRY IN DRESDEN. (*Textilber.*, **11**, 1930, p. 854. Abstr. from *J. of Text. Inst.*, xxii., **7**, 1931, A368.) A complete summary of the work of the Institute during 1930, showing that some 1,200 inquiries were dealt with during the period. Details are given of the publications issued.

575. ITALIAN COTTON INDUSTRY: ORGANIZATION. (*Text. Weekly*, **7**, 1931, p. 50. Abstr. from *Summ. of Curr. Lit.*, xi., **10**, 1931, p. 290.) A digest of a report by the Institute Nazionale per l'Esportazione, Rome. There are 993 businesses owning 1,250 mills or factories, employing 4,000 million lire capital and 250,000 persons. There are 120 spinning firms with 205 mills equipped with 5,450,000 spindles, but of these only one mill has more than 100,000 spindles. Counts are spun as fine as 200's. The 850 weaving concerns have 150,000 looms, 29 having 700 to 1,000 looms, 12 from 1,000 to 1,500, and 4 more than 1,500.

576. JAPANESE COTTON INDUSTRY: ORGANIZATION. (*Text. Weekly*, **7**, 1931, p. 40. Abstr. from *Summ. of Curr. Lit.*, xi., **10**, 1931, p. 290.) Statistics of spindles, looms, cotton consumption, and capital are given in support of the view that Japan will soon be able to compete in the market for better quality goods.

577. INFLUENCE DU NOMBRE DE VALVES DE LA CAPSULE SUR LA VALEUR TECHNOLOGIQUE DE QUELQUES COTONS DU MAROC. By F. Heim de Balsac and E. Miège. (*Coton et Cult. Cotonn.*, v., **3**, 1930, p. 213.) Tabulated results are given of determinations of length, fineness, and tensile strength made on samples grown in Morocco of Lone Star, Porto Rico, Durango, and Acala cottons from bolls with 3 to 5 locks. There appeared to be no definite relation between the number of locks per boll and the properties tested.

578. PORTO RICO. *Cotton Cultivation.* (*Cotton*, M/c., July 11, 1931.) According to the Assistant Commissioner of Agriculture at San Juan, Porto Rico produced last year 3,150 bales of lint cotton of 500 lb. each of Sea Island cotton, white in colour, and with a staple of over 2 in. long. 13,000 acres were cultivated last year, and this year the acreage planted to cotton is about 20,000 acres. The cotton planted on the north-western part of Porto Rico is cultivated in small farms owned by the farmers themselves; on the southern coast larger landholders are becoming interested in cotton. The approximate cost of land per acre suitable for cotton cultivation fluctuates between $50 and $100, and there are lands for sale.

579. RUSSIAN COTTON: CULTIVATION. By S. J. Kennedy. (*Text. World*, **79**, 1931, pp. 1094-5. Abstr. from *Summ. of Curr. Lit.*, xi., **10**, 1931, p. 255.) A review of developments under the Soviet "Five-Year Plan." The output for 1933 is expected to be 3,680,000 bales (of 478 lb.). After supplying the expected home requirements, this would leave 700,000 bales for export.

580. RUSSIAN TEXTILE INDUSTRY: ORGANIZATION. (*Text. Weekly*, **7**, 1931, pp. 143-4, 168-9, and 200-1. Abstr. from *Summ. of Curr. Lit.*, xi., **10**, 1931, p. 290.) A review of the section of the Soviet "Five-Year Plan" concerned with (*a*) cotton cultivation, (*b*) spinning and weaving, and (*c*) marketing and distribution.

581. Cotton Growing in the U.S.S.R. (*Econ. Survey*, v., **19**, 1930, Moscow.) Deals with the development of cotton growing in new regions, the extension of cotton growing in old areas by means of irrigation, the popularization of the transplantation method, the sowing of Egyptian cotton, the introduction of collective farming, etc.

SOILS AND MANURES.

582. Soil Erosion. (*Tech. Communication No.* 5, 1930, Imp. Bur. of Soil Sci., Rothamsted.) A summary of the published experimental work on soil erosion and of the recorded results obtained by the use of preventive measures, and a general bibliography of the literature on the subject.

A supplementary note to the above (*Tech. Comm. No.* 16, 1931) deals with administrative action in the Empire; experiments in Nyasaland, Uganda, and United States; physical and chemical properties related to erosion.

583. Soil Surveys and their Utilization. By L. L. Lee. (*Jour. of Min. of Agr.*, London, xxxvii., **7**, 1930, p. 653. Abstr. from *Int. Rev. of Agr.*, xxii., **12**, 1930, p. 443.) A study of soil surveys in the United States and their utilization, treating in order: the American methods of soil classification; soil mapping; determination of soil types; reports on soil surveys; value of these surveys to research institutions; value of surveys for farmers and the proper utilization of the soil.

584. The American Method of Soil Classification and Survey. By L. L. Lee. (*Tech. Comm. No.* 6, 1930, Imp. Bur. of Soil Sci., Rothamsted.) Discusses the American method of soil classification; the American soil survey organization; recognition and examination of soil types in the field; correlation of soil types; the application of the American system to other parts of the world.

585. The Possibilities of an International System for the Classification of Soils. By L. L. Lee. (*The Jour. of the South-Eastern Agr. Coll., Wye, Kent, No.* 28, 1931, p. 65.) A consideration of the influence of geology and climate on soil types, with a comparative study of South-East England and Central New Jersey, U.S.A. An introduction and review of the literature on the subject is presented, and the various methods of soil classification are discussed.

586. A Preliminary Survey of the Soils of Kenya. By D. S. Gracie. (*Bull.* 1, 1928p., Dpt. of Agr., Kenya.) Deals with the field methods used, the meaning of the analytical determinations made, soil organic matter, subsoil conditions, soil colour, soils of the various districts, the improvement and upkeep of soil fertility.

587. Report of the Second International Soil Congress, Russia, 1930. We have received two reports on the above Congress: (1) by Prof. N. M. Comber and Drs. E. M. Crowther and H. L. Richardson. The authors state that in addition to the specific study of soil problems they were enabled to see many objects which are playing important parts in the reorganization of Russian agriculture. They visited a large Soviet farm and also some of the implement and tractor factories, and had some opportunity of gaining an insight into Russia's scheme of industrial development considered as a whole.

(2) In the report by Dr. R. Hart the problems dealt with were those of the classification, nomenclature, and mapping of soils. An account is also given of the tour through European Russia, with a general description of the soils examined.

588. Sudan. *Soils in the Gezira.* (*Rpt. of Govt. Chemist*, 1930, p. 19.) "An experiment has been started to compare various soil improvers. The treatments are gypsum, ferrous sulphate, calcium chloride, sulphur, and control in com-

bination with ammonium sulphate, and also alone. The ammonium sulphate is applied in heavy dressings, with a view to observing the effect of the residual sulphate as a soil improver. The appearance of the crop shows that both soil improvers and nitrogen are increasing the yield. The examination of soil samples is in progress."

589. AIR SURVEY IN RELATION TO SOIL SURVEY. By R. Bourne. (*Tech. Comm. No.* 19, 1931, Imp. Bur. of Soil Sci., Rothamsted.) A general review of the history and problems of air survey, with directions as to the tests which should be applied wherever facilities are available for getting into the air or for working with air photographs, and an outline of the general procedure to be adopted with a view to achieving the maximum results at the minimum cost.

590. A NEW DISPERSION APPARATUS FOR THE MECHANICAL ANALYSIS OF SOILS. By J. Gollan. (*Ann. Sci. Agr. Franc. et Etrang.*, xlvii., **2**, 1930, pp. 142-158, Abstr. from *Exp. Sta. Rec.*, lxiv., **6**, 1931, p. 519.) A description and illustration of an apparatus said to give results practically the same as those obtained with the Kopecky device are here presented with some experimental detail. Advantages of the new apparatus over previously described arrangements for such purposes, as claimed by the devisers of the present set-up, are (1) easier and cheaper construction; (2) smaller size, permitting the setting up of a battery of apparatus in a limited space; (3) more exact regulation; and (4) avoidance of the necessity for taking down the apparatus to remove the particles of the last fraction determined.

In comparison with the sedimentation method, the results with the new apparatus were found practically identical in the cases of all soils which contained only a limited proportion of the coarser particles. For soils containing a large proportion of the coarser materials the levigation apparatus is said to have been more satisfactory and practically equal in rapidity. The pre-treatment advised by the International Commission was found superior to that of Kopecky in that it yields a good dispersion of the colloidal material, and is effective in the separation of all the other fractions with the sediment obtained in the first operation without regard to the nature, even if highly calcareous, of the water used. It is considered finally that by making the apparatus of suitable dimensions it would be possible to use it in the separation of mineral species in petrographic analysis and for separating the constituent particles of various powdered materials such as cements, fertilizers, etc.

591. DISPERSION OF SOIL BY A SUPERSONIC METHOD. By L. B. Olmstead. (*J. of Agr. Res.*, xlii., **12**, 1931, p. 841.) Describes a method of dispersing soil material by means of supersonic waves, and the apparatus used.

592. THE COLORIMETRIC DETERMINATION OF PHOSPHORIC ACID IN HYDROCHLORIC ACID AND CITRIC ACID EXTRACTS OF SOILS. By R. G. Warren and A. J. Pugh. (Reprint from *J. of Agr. Sci.*, xx., **4**, 1930.) The colorimetric determination of phosphoric acid in hydrochloric and citric acid extracts of soils by a method involving the evaporation of the extract, ignition and acid extraction of the residue with either the Deniges or Fiske-Subbarow methods of colour development, was satisfactory only with light soils. Clay soils gave low results owing to the presence of larger amounts of iron. A method is given in which the organic matter and iron are removed by treatment with sodium permanganate and potassium ferrocyanide. The results are in good agreement with the gravimetric method.

593. ORGANIC COMPOUNDS ASSOCIATED WITH BASE EXCHANGE REACTIONS IN SOILS. By W. T. McGeorge. (*Tect. Bull. No.* 31, Univ. of Arizona Coll. of Agr., 1931.) From the summary we extract the following: The exchange capacity of the lignin present in soils was not a constant quantity, but varied in different soils. Synthetic humus, prepared from xylan or cellulose, like that prepared from

sucrose, yielded materials with rather high base-exchange capacities. Green manure (ground dry alfalfa) showed an appreciable base exchange capacity, a large part of which was not easily destroyed by digestion with H_2O_2. The base exchange capacity of ground alfalfa was increased fourfold by spontaneous decomposition. All the investigations showed that the exchange capacity of the organic fraction increased as the organic matter passed through successive stages of decomposition in the soil.

594. COTTON PLANT: EFFECT OF SOIL TEMPERATURE ON DEVELOPMENT. By K. B. Flerov and S. I. Jakubzov. (*Bot. Centr.*, **18**, 1931, p. 281; from *Rep. Inst. Exper. Agron., Leningrad*, **37**, 1929. Russian, with English summary. Abstr. from *Summ. of Curr. Lit.*, xi., **13**, 1931, p. 352.) With soil temperatures of 25° to 30° the development of the plant is completed up to one month earlier, and the total dry substance of the plant is about three times that of a plant raised in soil at 20°. The latter has about twice as great a root mass as that grown at 30°. With soil temperatures of 20° cotton plants show symptoms of heat hunger.

595. SURVEY OF THE FERTILIZER INDUSTRY. By P. E. Howard. (*U.S. Dpt. Agr. Circ.*, **129**, 1931, p. 23. Abstr. from *Exp. Sta. Rec.*, lxiv., **6**, 1931, p. 525.) Following a very brief historical sketch, the circular outlines: (1) the world industry under the subheads: location of consumption, materials produced, summary of values, world inorganic nitrogen production, world phosphate fertilizer production, and world potash production; (2) the fertilizer industry in the United States, taking up production and consumption statistics, progress since 1914, location of production and consumption, imports and exports, some values involved, potash, phosphate, and nitrogen supply.

It is stated that " although the total tonnage increase of commercial fertilizers from 1914 to 1928 amounted to only 6 per cent., there was an increase of about 100 per cent. in total nitrogen content, 16 per cent. in total potash, and 40 per cent. in phosphoric acid, the total plant-food content increase being 45 per cent."

596. DETERMINATION OF EXCHANGEABLE BASES AND LIME REQUIREMENT. (*Tech. Comm. No.* 12, 1930, Imp. Bur. of Soil Sci., Rothamsted.) Part I. deals with methods applicable in the absence of soluble salts; methods applicable to soils containing soluble salts; application of electrodialysis. Part II. describes methods for determining exchangeable hydrogen, saturation capacity, and lime requirement.

597. INFLUENCE OF POTASH SOURCES AND CHLORINE CONTENT OF FERTILIZERS ON YIELD OF COTTON. By J. J. Skinner. (*J. Amer. Soc. Agron.*, **23**, 1931. Abstr. from *Pubns. Relating to Soils and Fertilizers List No.* 1, 1931, Imp. Bur. of Soil Sci., Rothamsted.) Describes experiments comparing chloride and sulphate of potash and kainite. The amount of chlorine is excessive when heavy dressings of mixed fertilizer containing KCl and ammonium chloride are applied to cotton.

598. RESULTS OF FERTILIZER EXPERIMENTS ON NORFOLK FINE SANDY LOAM AND ON NORFOLK SANDY LOAM. By J. J. Skinner. (*U.S.D.A. Tech. Bull. No.* 225, 1931. Abstr. *Publications Relating to Soils and Fertilizers List No.* 1, 1931, Imp. Bur. Soil Sci., Rothamsted.) An account of ten years' fertilizer experiments with cotton and maize rotation. Optimum fertilizer mixtures discussed.

599. SUDAN. *Field Experiments.* (*Rpt. of Govt. Chemist*, 1930, p. 16.) In manurial trials carried out in conjunction with the Government Botanist at Shambat, the following manures were employed: Ammonium sulphate, Nitrochalk, Ephos phosphate, Ammonium sulphate+Ephos phosphate. The final yields of seed cotton confirm previous findings that phosphatic manures exert no beneficial effect on the cotton crop at this station. Counts of plants infected with leaf crinkle were made throughout all the plots, but no significant differences could be

detected, the total amount of disease being 0·5 per cent. distributed uniformly over the area.

During the year 3,747 samples of plant tissue were received for the determination of nitrogen in connection with the experiments carried out at Medani by the Plant Physiologist. The main experiment was the four factor, comprising interaction of water duty, spacing, nitrogenous manures and date of sowing. This comprises seventy-two combinations. The main point shown by these experiments was the maximum reached in mid-October, and the general falling away from then, this falling away being much less marked in the later sowings. The results have demonstrated the remarkable difference of response to ammonium sulphate when applied to cotton of different sowing dates. In the case of spacing and ammonium sulphate the response of the closer spaced plants is much more marked than in the wider spacing.

CULTIVATION, IRRIGATION, GINNING, USE OF SEED, ETC.

600. Cotton Ginning Machinery. By Platt Bros. and Co., Ltd., Oldham. *Text. Rec.*, xlix., **578**, 1931, p. 46.) Describes a full air blast pneumatic saw gin and a Macarthy knife and roller gin.

601. Cotton Gin on Wheels. (*Pop. Mech.*, Chicago, June, 1931.) A curious machine on wheels has been travelling over the railroads of western Mexico, where many thousands of acres have lately been planted to cotton in regions where cotton gins, if present at all, are few and far between. In this emergency, an enterprising Texas firm conceived the idea of building a gin into a box car and sending it to the cotton—instead of depending on the more toilsome process of bringing the cotton over the mountains to the gin. The "despepitamovil," as this box-car gin is called, moved from place to place, and turned out many thousands of neat round bales. The despepitamovil is the only machine of its kind, but there are some 300 stationary ones of similar make scattered over Texas and Oklahoma. These are the new-style gins which turn out cotton pressed to high density in compact cylinders of 250 lb. each, in place of the old style square bale. The old conventional square bale, with its exposed sides, cut bagging, and bulky shape, has long been condemned as wasteful, costly to handle, and liable to fire risk, pilferage, and weather damage. The more compact round bale, which is pressed once for all and requires no compressing or recompressing, has been coming increasingly to the fore in recent years.

602. Cottonseed Oil: Production. By E. L. Carpenter and L. Holdredge. (*Mech. Eng.*, **53**, 1931, p. 353. Abstr. from *Summ. of Curr. Lit.*, xi., **13**, 1931, p. 372.) A review of the history, economics, processes, and problems of the cottonseed oil industry.

PESTS, DISEASES, AND INJURIES, AND THEIR CONTROL.

603. Bordeaux Mixture: Simple Directions for its Preparation in Either Small or Large Quantities. By H. A. Pittman. (*J. Dpt. Agr. Western Australia*, 2nd ser., vii., **4**, 1930, p. 600. Abstr. from *Rev. App. Mycol.*, x., **7**, 1931, p. 474.) A paper, written in popular language, pointing out the advantages and drawbacks of Bordeaux mixture as compared with other liquid fungicides, and giving detailed instructions for the home preparation of the mixture both in large and small holdings. A list is appended of spreaders other than calcium caseinate, which may be used when the latter is unobtainable.

604. La Désinfection des Graines de Coton. By P. Staner. (*Coton et Cult. Cotonn.*, v., **3**, 1930, p. 220.) Describes the apparatus of Simons and of P. Mallet

for the disinfection of seed by hot air, and also the apparatus of Clayton for disinfection by gas.

605. Les Ennemis du Coton en Algérie, et les Moyens Employés pour les Combattre. By Delassus and Lepigre. (*Coton et Cult. Cotonn.*, v., **3**, 1930, p. 183.) Among the causes which have contributed to the decrease in the cotton area of Algeria from 8,000 hectares in 1925 to 5,000 at the present day have been attacks of pests, in particular *Earias insulana*, to which was added later an attack of pink bollworm (*Gelechia gossypiella*). *Heliothis obsoleta* also causes injury to cotton, but to a lesser degree. This pest and *Earias insulana* are largely combated by the use of maize as a trap crop. It has been found that the advent of pink bollworm has been followed by a decrease in *Earias*—this has also been observed elsewhere. Many remedies, biological or otherwise, have been tried against these and other pests, and results and useful notes will be found in this paper.

606. Considérations Entomologiques sur la Culture du Coton en Somalie Italienne. By A. Chiaromonte. (*Coton et Cult. Cotonn.*, v., **3**, 1930, p. 244.) A general account of harmful insects, and of biological and other methods of combating them.

607. Mississippi. *Cotton Pests*. By R. W. Harned. (*Miss. Sta. Rpt.*, 1929. Abstr. from *Exp. Sta. Rec.*, lxiv., **5**, 1931, p. 454.) In reporting upon cotton aphid investigations in 1928-29, it is stated that there was considerable indication that the continued use of nicotine dust is deleterious to cotton production. Four plats given thirteen applications of nicotine dust showed an average loss of 4 lb. per acre for the crop.

608. Cotton Pests in South Carolina, 1930. By C. O. Eddy. (*S. Car. Sta. Rpt.*, 1930. Abstr. from *Exp. Sta. Rec.*, lxiv., **7**, 1931, p. 652.) Much damage was done to seedling cotton throughout the major portion of the State in the growing season by the onion thrips, and *Frankliniella fusca* Hinds, which caused similar injury.

609. Russia. We have received a copy of *Bull. of Plant Protection. Entomology*, vol. i., No. 1, 1930, from the Inst. for Plant Protection, Leningrad. It contains, among others, the following articles in Russian, with English summaries : " The Zonal and Ecological Distribution of *Acrididæ* in West Siberian and Zaisan Plains " (G. J. Bey-Bienko); " Studies on the Dermoptera and Orthoptera of the Omsk District, West Siberia " (G. J. Bey-Bienko); " The Fall Generation of *Locusta migratoria* L. in Daghestan in 1927 " (A. M. Franzi and N. N. Djukov); " Contributions to the Study of the Flies Parasitic on the Larval and Adult Instars of the Migratory Locust " (B. I. Rukavishnikov); " On the Biometrical Characteristics of the Races of the Asiatic Locust " (V. Makalovskaja).

610. Measures of Control of Cotton Pests in the Uzbek S.S.R. in 1930. By M. I. Kosobutzkii. (In Russian.) (*La Rekonstr. sel'sk. Khoz.*, ii., **5-6**, p. 120, Samarkand, 1930. Abstr. from *Rev. App. Ent.*, xix., Ser. A., **6**, 1931, p. 370.) Notes are given on the distribution and economic importance of the following cotton pests in Uzbekistan, recorded under their popular names: *Tetranychus telarius*, L.; *Aphis gossypii*, Glov.; *Calliptamus italicus*, L.; *Laphygma exigua*, Hb.; *Euxoa segetum*, Schiff.; and *Heliothis obsoleta*, F. The programme of work against them in 1930 is briefly outlined, and the difficulties encountered in the organization of control measures are discussed.

611. Cotton Insect Pests in the Sudan. (*Wellcome Trop. Res. Labs. Bull. No.* 31, Entomol. Sect., 1930. Abstr. from *Summ. of Curr. Lit.*, xi., **11**, 1931, p. 321.) *Investigations in the Gezira*. By H. B. Johnston. The report gives a summary of the observations on cotton thrips, pink bollworm, leaf crinkle, dura stem-borer, orthoptera, and insects of minor importance carried out at the Gezira laboratory in 1929.

Investigations in Berber. By J. W. Cowland. The work of the laboratory in 1929 is outlined, and observations on the occurrence of pink bollworm, Sudan bollworm, Egyptian bollworm, crickets, Gabura, locusts, dura stem-borer, and the berseem worm are recorded.

Investigations in Talodi. By F. G. S. Whitfield. A survey of the insect pests of cotton throughout the province showed that the damage due to the cotton leaf-roller (*Sylepta derogata*) was very local and not serious. Cotton stainers constitute the most serious pest. Control measures employed consisted of a paraffin spray, and in certain circumstances burning. Pink bollworm occurs throughout the province, but appears to cause little damage. Spiny bollworm, cotton flea-beetle, and cotton stem-borer have occurred in small numbers. Serious damage was caused by blackarm disease.

Investigations in Mongalla. By W. Ruttledge. The greatest injury was caused by cotton stainers, and an outline is given of the probable annual cycle of this pest in the province. Other pests include American bollworm, pink bollworm, seed bugs, jassids, spiny bollworm, and cotton aphis. Blackarm disease is widespread and causes considerable damage.

612. A Report on Work carried out at the Khartoum Laboratory during 1929. By H. W. Bedford. (*Wellcome Trop. Res. Labs. Bull. No.* 31, Ent. Section. Khartoum, 1930, p. 33. Abstr. from *Rev. App. Ent.*, xix., Ser. A, **6**, 1931, p. 391.) Owing to the negligible numbers of *Diparopsis castanea*, Hmps. (Sudan Bollworm) occurring in 1929 in the vicinity of Khartoum, the breeding of *Microbracon brevicornis*, Wesm., was ultimately discontinued. In February an additional host of this parasite was found, the Noctuid, *Eublemma baccalix*, Swinh., the larvæ of which feed inside the flowers of morning glory (*Ipomœa rubrocœrulea*). The alternative host of *M. kirkpatricki*, Wlkn., which has been identified as the Tortricid, *Crocidosema plebeiana*, Zell., was observed to be extremely active on *Abutilon* spp. during August-October, the normal time for the sowing of cotton and the growth of its early stages, prior to the appearance of *Platyedra gossypiella*, Saund. Observations on fruits of *Abutilon* spp. show that these plants act as alternative hosts of two cotton pests, *Earias insulana*, Boisd., and *Oxycarenus hyalinipennis*, Costa. The former is often attacked by parasites of other pests of cotton, including *M. brevicornis*, *Elasmus johnstoni*, Ferr., and *Apanteles earterus*, Wlkn. It therefore appears that these plants should be encouraged in order to act as a reservoir for these parasites during the dead season for cotton, and to attract *E. insulana* during the cotton season.

613. Cotton Pests in Tanganyika. (*Ann. Rpt. of Dpt. of Agr.*, 1929-30, Part II., p. 39.) The reduction of the infestation of cotton by pink bollworm to 1·7 per cent. of the boll locules in an area where in 1922 the infestation varied from 30 to 40 per cent. is attributed to the curtailment of the cotton season and the improved observance of the close season. Another pest, *Apion xanthostylum*, Wagn., has almost entirely disappeared from the cotton fields owing to the improved conditions. Recent work in the United States on the application of micaceous dusts for the control of Lepidopterous larvæ lends interest to the fact that in the Morogoro cotton area, where the soils are highly micaceous, seed cotton passed through rotary openers is cleaned of a high percentage of pink bollworm, and larvæ taken from the dusting refuse, which contains soil material, fail to develop.

614. Cotton or Weevils. By J. L. Webb and F. A. Merrill. (*Misc. Pub. U.S. Dpt. Agr. No.* 35, Washington, D.C., 1930. Abstr. from *Rev. App. Ent.*, xix., Ser. A, **5**, 1931, p. 309.) A popular account is given of the bionomics and control of the cotton boll-weevil (*Anthonomus grandis*, Boh.) in the United States.

615. STUDIES OF THE MEXICAN COTTON BOLL WEEVIL. By F. F. Bondy. (*S. Car. Sta. Rpt.*, 1930. Abstr. from *Exp. Sta. Rec.*, lxiv., 7, 1931, p. 655.) Describes hibernation experiments with the boll weevil.

616. TIME OF HATCHING FIRST GENERATION BOLL WEEVILS RELATIVE TO APPEARANCE OF COTTON BLOSSOMS. By P. Calhoun. (*Fla. Ent.*, xiv., 4, 1930. Abstr. from *Exp. Sta. Rec.*, lxiv., 6, 1931, p. 550.) This contribution from the Florida Experiment Station includes information in tabular form on the time required for both Upland and Sea Island squares of various sizes to bloom. The time required for squares to bloom, sizes of squares being measured, is charted.

617. STUDIES ON *Platyedra gossypiella*, SAUND., IN THE PUNJAB: PART II., THE SOURCES OF *P. gossypiella* INFESTATION. By M. Afzal Husain *et el.* (*Ind. Jour. of Agr. Sci.*, i., 2, 1931, p. 204.) "In the Punjab the life-cycle of pink bollworm consists of two different types, the short-cycle and the long-cycle. In the first case the duration of each life-cycle varies from nineteen to thirty-seven days, and there may be four broods from August, when the attack starts, to November, when hibernation occurs. In the second case the caterpillars hibernate. The period of hibernation extends to the next summer, normally to July-August. The maximum duration of this brood so far recorded has been ten months. The infestation is carried from one cotton crop to another by the moths developing from long-cycle caterpillars. Moths emerging up to the end of June cannot breed as food is not available. The first brood of the worms that appears in the cotton fields is the progeny of moths emerging in July." It is considered that the pest is carried over from one season to another in cotton seed, cotton stalks, and cotton refuse in ginning factories.

[*Cf.* Abstr. 76, Vol. VI. of this Review.]

618. PINK BOLLWORM: OCCURRENCE IN THE GEZIRA (SUDAN) DURING 1929. By T. W. Kirkpatrick. (*Wellcome Trop. Res. Lab. Bull. No.* 31, Ent. Section, 1930, p. 48. Abstr. from *Summ. of Curr. Lit.*, xi., 12, 1931, p. 322.) The results of an examination of the rate of infestation of green bolls at three selected localities are given. The pink bollworm has so far been less serious in the Gezira area than in Egypt. The difference is largely due to fundamental differences in the climatic conditions of the two countries during the season when the cotton is maturing. In Egypt this takes place at the warmest time of the year (July to September), whereas in the Gezira the bolls are forming and the pink bollworm consequently breeding during the coldest months. There is considerable evidence to show that the pink bollworm is scarcely able to do more than maintain its numbers during the weather that normally prevails in the Gezira from the middle of November to the middle of January. When the short-cycle worms are full fed, they leave the bolls and descend to the ground in order to pupate, either under dead leaves, etc., or in the top few inches of soil. It is highly probable that among those which descend cracks in the soil there is a considerable mortality owing to their being more or less sealed up after an irrigation in the stiff Gezira clay, while others on the ground are killed by the heat of the sun during February and March. The resting larvæ which are picked with the cotton are destroyed by the sunning of the seed after ginning. Others in the resting stage survive on stolen cotton which escapes being exported or sunned. Preliminary experiments indicate that the great majority of moths from such long-cycle worms emerge in July and August, and die without any prospect of reproduction. Worms contained in cotton and dead bolls which fall to the ground are probably either killed by the sun during April and May, or fall down cracks in the soil, where they are attacked by rats and termites, or sealed up in the clay after the first heavy rains. It therefore appears that a low incidence of pink bollworm in the Gezira depends on low winter temperatures, efficient destruction of the worms contained in the seed

628. Some Facts about the Use of Poisoned Bait and Portable Screens for Combating *Schistocerca gregaria* Forsk. By S. A. Kharin. (In Russian, with English summary.) (*Proc. All-Union Sci. Res. Inst. Cott. Cult. Ind.*, **31**, Tashkent, 1931. Price 65 kop. Abstr. from *Rev. App. Ent.*, xix., Ser. A, 7, 1931, p. 407.) Portable iron barriers combined with trap-pits proved very effective in the control of hoppers of *Schistocerca gregaria* Forsk. in Turkmenistan, the failures being usually due to faulty technique. The best results with baits were obtained with 2 to 7 oz. sodium arsenite to 10 lb. cottonseed meal. Baits proved successful even when used against adult locusts.

629. Physiology of Cotton Infested with *Epitetranychus*. By D. Blagoveshchenskii *et al.* (In Russian, with English summary.) (*Proc. All-Union Sci. Res. Inst. Cott. Cult. Ind.*, **23**, Tashkent, 1931. Price 35 kop. Abstr. from *Rev. App. Ent.*, xix., Ser. A, 7, 1931, p. 408.) A detailed account of experiments during 1929, which shows that infestation of cotton in Central Asia by *Tetranychus* (*Epitetranychus*) [*telarius*, L.] seriously disorganizes the physiological functions of the leaves and thus generally affects the development of the plants.

630. An Attempt to Estimate from an Agricultural Point of View the Damage caused to Cotton by the Red Spider (*Epitetranychus althææ* v. Hanst.). By V. A. Lebedeva. (In Russian.) (*Byull. Sr.-Az. Inst. Zashch. Rast.*, No. 21, Tashkent, 1931. Price 1 rub. Abstr. from *Rev. App. Ent.*, xix., Ser. A, 7, 1931, p. 408.) A detailed account of field experiments carried out in 1927-29 in eastern Uzbekistan, chiefly to determine the resistance of different varieties of cotton to infestation by *Tetranychus telarius*, L. (*Epitetranychus althææ*, v. Hanst.). Two varieties were fairly resistant to the pest, whereas a marked preference was shown for one variety, which also proved very susceptible. The effect of various manures on infested and uninfested plants was observed; the author considers that infestation usually decreases the yield of the crop to such an extent that the improvement resulting from manuring is of no practical value. As regards the effect of infestation at different periods on the yield of the crop, injury before and during the formation of the buds is the most important.

631. Cotton Thrips: Control in the Gezira, Sudan. By W. P. L. Cameron. (*Wellcome Trop. Res. Lab. Bull. No.* 31, Ent. Section, 1930, p. 55. Abstr. from *Summ. of Curr. Lit.*, xi., 11, 1931, p. 322.) The history of cotton thrips in the Gezira in 1929 is outlined, and the habits of the pest are discussed in relation to environmental changes. Tests of the value of irrigation periods arranged to coincide with the presence of the maximum number of pupæ in the soil show that the ridges where the majority of the thrips pupate must be completely flooded in order to check the pest effectively under normal Gezira soil conditions. The sowing of *Cajanus indicus*, Spreng ("Ads sudani")—a plant which is little affected by thrips—on the higher ridges is advantageous, especially with July and August sown cotton. The plant should be of the same age as the cotton. Preliminary experiments with late sown cotton and weeds as trap crops are reported.

632. Traps for Tsetse Flies. *A Zululand Experiment.* (*Times*, March 16, 1931, p. 17.) Describes a trap invented by Mr. R. H. T. P. Harris, an entomologist engaged in the campaign against tsetse flies in Natal. The traps are made of strips of wood, wire netting, and hessian cloth, the materials for each costing about 30s., and it is claimed that they have been very successful in catching the adult insects. An account of the invention has been published in a blue pamphlet under the authority of the Province of Natal by the Natal Witness Press, Pietermaritzburg.

633. Industrial Microbiology. By H. F. Smyth and W. L. Obold. (Pubd. Baillière, Tindall and Cox, London, 1930. Price 27s.) A manual and guide-book on the utilization of bacteria, yeasts, and moulds in industrial processes.

634. Thionin and Orange G for the Differential Staining of Bacteria and Fungi in Plant Tissues. By H. R. Stoughton. (*Ann. of App. Biology*, xvii., 1, 1930, p. 162.) In the course of studies on the disease of cotton caused by the organism *Bacterium malvacearum* the need arose for a method of tracing the progress of the organisms through the tissues of the host. Sections were stained by many different methods, most of the well-known combinations, such as the Pianeze stain as used by Vaughan, the Giemsa stain as modified by Wright and Skoric, Ziehl's carbol-fuchsin and light green, iron alum hæmatoxylin, and so on, being tried, as well as a number of other combinations. None, however, gave a really satisfactory result.

The organism produces a considerable amount of slime, and this stains very readily, with the result that the bacteria are obscured by the diffuse stain. Further, none of the combinations referred to differentiated between the slime and the host tissues.

Thionin is well known as a stain for differentiating mucin in animal tissues owing to its high metachromasy, mucin being stained pink, and other tissues shades of blue and purple. Used in aqueous or phenol solution on diseased plant tissue it gave very promising results, but the required degree of differentiation of host and parasite was not obtained owing to the intense staining of the host tissue. Orange G in alcoholic solution was, however, found to be a good differentiating agent, and at the same time acted as an excellent counter-stain for the cellulose walls.

The technique adopted was as follows:

Paraffin Sections.—(1) Xylol to remove wax. (2) Grade through alcohols to water. (3) Stain in the following solution one hour: thionin, 0·1 gm.; 5 per cent. solution of phenol in distilled water 100 c.c. (4) Grade through alcohols to absolute alcohol. (5) Differentiate in a saturated solution of orange G in absolute alcohol. (6) Wash thoroughly in absolute alcohol. (7) Xylol-alcohol. (8) Xylol. (9) Mount in balsam.

The differentiation is accomplished fairly quickly, usually in about half to one minute. The progress may be controlled under the microscope, but with a little practice satisfactory differentiation can be carried out by eye observation only. The treatment with orange G is continued until the sections lose their bluish-purple colour and become uniformly yellowish green.

In plant tissues the parasite is stained violet-purple, cellulose walls yellow or green, lignified tissue blue, nuclei pale blue with purple nucleoli, and chromosomes in dividing nuclei deep blue on a purple spindle. Nuclei in fungal hyphæ are clearly picked out in deep purple.

For hand sections the procedure may be shorter. (1) Sections in water. (2) Stain in carbol-thionin five minutes. (3) Wash in water. (4) 95 per cent. alcohol. (5) Differentiate in the solution of orange G (several minutes). (6) Wash well in absolute alcohol. (7) Clear in xylol. (8) Mount in balsam.

The stain has been found to give good results with such different materials as *Bacterium malvacearum* on *Gossypium*, *B. radicicola* in root nodules of legumes, *Plasmodiophora* on *Brassica*, *Synchytrium endobioticum* on *Solanum*, *Peronospora* on *Capsella*, *Phytophthora* and *Sclerotinia* on seedlings, *Botrytis* on *Allium*, and *Puccinia* on *Anemone*. The procedure is so rapid and so easily carried out that the stain combination should prove of value for class purposes.

Apparently any reliable brand of thionin is satisfactory; good results have been obtained with a sample from British Drug Houses, and also with the "Soloid" brand tabloids of Messrs. Burroughs Wellcome and Co.

A modification which may prove of value in particular cases is to remove the orange stain by regrading the sections to water after differentiation, and then running up again to xylol. By this means all the orange is removed, leaving the parasite very conspicuous against unstained walls.

635. THE RELATION OF ENVIRONMENTAL CONDITIONS TO ANGULAR LEAF-SPOT DISEASE OF COTTON. By R. Stoughton. (*Ann. App. Biol.*, xvii., 1930, p. 188. From *Abstracts of Papers on Agr. Res. in the U.K.*, 1929-30, p. 57.) An account of experiments carried out in a small experimental chamber, showing that temperature and humidity are interrelated factors in their effect on disease. An abstract of a paper read to the Association of Economic Biologists.

636. THE MORPHOLOGY AND CYTOLOGY OF *Bacterium malvacearum* E.F.S. By R. Stoughton. (*Fifth Internat. Bot. Congr. Abstracts of Communications*, Cambs., 1930, p. 16. From *Abstracts of Papers on Agr. Res. in the U.K.*, 1929-30, p. 58.) An account of the nuclear-like division process in *B. malvacearum*, and of the formation and subsequent germination of the spherical reproductive bodies.

(*Cf.* Abstr. 249, Vol. VII., p. 159, of this Review.]

637. ADMINISTRATION REPORT OF THE MYCOLOGIST, COIMBATORE, 1929-30. By S. Sundararaman. (Abstr. from *Rev. App. Mycol.*, x., 6, 1931, p. 360.) *Cotton Diseases.*—The boll rot and seedling blight of cotton (*Gossypium herbaceum*), caused by *Colletotrichum* (*Vermicularia*), resulted in an average loss of weight in seed cotton of 48·4 per cent., and a reduction in the ginning percentage of 9·8 per cent. The percentages of infected seedlings developing from two lots of diseased bolls were 29 and 34, respectively, while those from healthy bolls were quite free from blight. The causal organism of this disease has been found to occur on the common weed *Aristolochia bracteata*, cross-inoculation tests with which and *G. herbaceum* gave positive results.

638. MARCIUME DEL COLLETTO DI PIANTINE DI COTONE APPENA GERMINANTI. By G. Lindegg. (*Riv. Pat. Veg.*, xx., 1-2, 1930, pp. 9-17. Abstr. from *Rev. App. Mycol.*, x., 5, 1931, p. 309.) A description is given of a collar rot of young cotton seedlings growing in a bed in which tomatoes a few weeks previously had been killed off by a closely similar condition. The root and part of the hypocotylar axis were rotted, discoloured, and flaccid; the cotyledons became yellow and soft and curled at the margins, and the seedlings rapidly withered and died. In advanced stages the stems easily broke at the collar. Infected material showed the presence of a hyaline, branched, septate mycelium with very numerous hyaline, fusiform, straight or falcate, 0- to 5-septate conidia (a few of which were swollen between the septa) containing large refracting oil drops, and measuring 8·4 to 16·8 μ in length for the smaller 1- to 2-septate conidia, while the 3- to 5-septate ones measured 16·8 to 40·8 by 3·6 to 6 μ. The fungus was identified as *Fusarium vasinfectum.* The disease, which is attributed to unsuitable cultural and soil conditions, was successfully controlled by removing the affected plants, thinning out the remainder, and applying to the soil powdered iron sulphate and quicklime mixed in equal parts.

639. COTTON ROOT-ROT AND ITS CONTROL. By J. J. Taubenhaus and W. N. Ezekiel. (*Bull. No.* 423, Texas Agr. Exp. Sta. Div. of Plant Path. and Phys., 1931.) Root-rot, which is caused by a fungus, *Phymatotrichum omnivorum*, occurs in at least 196 counties of Texas, and in at least thirty soil series; it attacks the roots of susceptible plants and causes them to decay. The vegetative strands of the fungus are found on the diseased roots, and the spore-mat stage is formed on the surface of the soil above the affected roots. Resting bodies, or sclerotia, are formed in the soil near the diseased roots, and aid in the survival of the fungus. Root-rot spreads from plant to plant chiefly along the roots, rather than by independent growth for long distances through the soil. Tentative recommenda-

tions for control are given. Emphasis is still placed on rotation with non-susceptible crops, together with clean culture, which should be practised throughout the entire rotation period, both while the crops are growing and during fall, winter and spring. Since sclerotia may survive in the soil for at least three years, rotations with grain sorghums, corn, wheat, oats, or other non-susceptible crops for three years are recommended. Various other possible means of control include attempts to acidify soils, the use of soil disinfectants, fertilizers and manures, deep ploughing and subsoiling, and testing and development of resistant varieties of cotton.

640. NUTRITIONAL STUDIES ON *Phymatotrichum omnivorum*. By W. N. Ezekiel *et al.* (Abstr. in *Phytopath.*, xxi., 1, 1931, p. 120. Abstr. from *Rev. App. Mycol.*, x., 6, 1931, p. 380.) *Phymatotrichum omnivorum* is stated to grow readily in synthetic media, even the sclerotial stage developing in cultures in which ammonium nitrate was the source of nitrogen and dextrose that of carbon. The heaviest growth was secured with a relatively large supply of dextrose and a lesser amount of some source of nitrogen, ammonium nitrate being the most favourable of those tested. Phosphate was essential, also potassium or magnesium, or possibly both. Iron, chlorine, and sulphate were omitted without much effect. At 28° to 29° C. the growth curves reached a peak in five weeks with a substratum high in dextrose, and in three weeks with a low dextrose content. The media became increasingly acid as the colonies developed, but ultimately tended towards alkalinity as the mycelium degenerated.

641. PRELIMINARY STUDIES ON THE EFFECT OF FLOODING ON PHYMATOTRICHUM ROOT ROT. By J. J. Taubenhaus *et al.* (*Amer. J. of Bot.*, xviii., 2, 1931, p. 95. Abstr. from *Rev. App. Mycol.*, x., 7, 1931, p. 454.) Observations during the past twelve years in Texas have shown that cotton root rot (*Phymatotrichum omnivorum*) is extremely uncommon in areas subject to periodical flooding, even in regions where the disease is prevalent. Root rot was introduced into a creek bottom in 1927 by the artificial inoculation of cotton plants, which succumbed to the disease. These plants were allowed to remain over winter, with the result that the disease reappeared on the cotton crop the following year, and spread considerably. The normal soil conditions, therefore, were evidently not unfavourable to the disease, the general absence of which on such lands would appear to be due to the state of the soil during or immediately after periods of inundation. In a laboratory test, strands of *P. omnivorum* on naturally infected cotton roots were inactivated by submergence in saturated soil for more than three days, while in a parallel series, at the same temperature but stored in moist air, the fungus was still viable after a fortnight and capable of attacking normal cotton plants.

Three seasons' flooding experiments in the field, for periods of up to 120 days at a time, failed to produce significant changes in the survival of root rot on cotton and cowpeas, or to eliminate the roots of plants that serve as carriers of the disease—*e.g.*, *Solanum elæagnifolium*—from the soil. The survival of the fungus in these experiments may be explained either by the failure of the water to penetrate to a sufficient depth, or by the presence of sclerotia capable of withstanding long periods of immersion.

642. STUDIES ON SCLEROTIA AND MYCELIAL STRANDS OF THE COTTON ROOT-ROT FUNGUS. By C. J. King *et al.* (*J. Agr. Res.*, xlii., 12, 1931, p. 827.) Inoculation experiments with sclerotia of the cotton root-rot fungus, *Phymatotrichum omnivorum*, showed that the disease could be communicated to healthy plants by these structures when stimulated by proper conditions. Air drying for one and a quarter hours in an open room or in a desiccator, or immersion for fifteen minutes in hot water at 46° C., was found sufficient to kill individual sclerotia. Sclerotia immersed in distilled water were 81 per cent. viable after ninety-two

days, but after 121 days in water only about 20 per cent. germinated. When simple sclerotia and sections of infected cotton roots ½ in. in diameter were placed in the centre of quart jars filled with sand and the jars immersed in water, a maximum temperature of about 43° C. maintained for two to four minutes was required to kill the sclerotia, while a temperature of about 51° was required to kill the mycelium on and in the root tissues. Individual sclerotia were killed by a 1 per cent. formalin solution and by a 1: 2,000 mercuric chloride solution in about thirty minutes, and by a 1: 1,000 mercuric chloride solution in four to five minutes. Sclerotia that were buried for three hours in large cores of undisturbed soil from one to six days after treatment of the soil with 1 per cent. and 1½ per cent. formalin solution, were killed, and the mycelium on sections of infected cotton roots ½ in. in diameter, buried in like manner for twelve hours in the treated soil, was killed during the first four days after the formalin treatment, but that on the roots inserted the sixth day remained alive. Root-rot sclerotia, exposed strands, and active mycelium on cotton root tissues, placed in glass tubes of sand, were killed when exposed for twenty-one hours to the gas liberated from a 1½ per cent. formalin solution. New sclerotia may be developed periodically in old cultures by a budding process on the surfaces of old sclerotial clusters, or directly from old strands, five or six months after the first sclerotia appear. It is indicated that the life of the fungus may be prolonged by this process. In one experiment root-rot strands during 149 days grew a distance of 3·2 metres (10·5 ft.) through a long glass tube which contained moist sand, with small deposits of dead root tissues placed at intervals of 2½ ft. It was observed in this and other tests that there was a tendency for sclerotia to develop on the strands soon after they had advanced beyond a fresh food supply. Their development was not immediate on the new filaments, but usually they formed continuously for several days on the increments of strand growth several days old between the food supply and the advance hyphæ. The ability of the strands to grow through long tubes of sand three times in succession without re-sterilization of the sand indicated that no toxic substances were left from the mycelium in the soil to interfere with subsequent growth when reinfected. It was apparent that some types of root-rot strands are sclerotial in character, and under favourable conditions remain viable for long periods. In a 2-ft. glass tube containing only small glass beads and distilled water, root-rot strands advanced a distance of 511 mm. in thirty-one days from the inoculum placed at one end, and developed sclerotia in great numbers over a distance of 250 mm. Some isolations of the fungus differed from others in vigour of growth and in the ability to develop sclerotia in great numbers. It is possible that differences in the behaviour of spots of infection in the field may be explained by such variations. There are some indications of staling in old root-rot cultures that have been maintained for long periods on artificial media.

643. THE WILT DISEASE AND THE FUTURE DEVELOPMENT OF COTTON GROWING IN THE DELTA OF THE NILE. By T. Fahmy. (*Afr. World,* Egypt and Sudan Annual, 1931, p. 51.) An interesting account of the disease, which first appeared in 1902 on Afifi cotton, a cross between Ashmouni and Sea Island. Details are given of the work that has been done in connection with the breeding of resistant strains, and there are now several varieties which are immune to the disease, among which may be mentioned Giza 7, 13, and 15, and Myco 3, 4, and 6. The author states that wilt disease in Egypt is no longer feared, since there are now immune varieties in existence from which, in a few years, it is hoped that enough seed will be available for wide distribution in the Delta.

644. MISSISSIPPI. *Experiments to Control Cotton Wilt.* By L. E. Miles. (*Miss. Sta. Rpt.,* 1929. Abstr. from *Exp. Sta. Rec.,* lxiv., 5, 1931, p. 446.) As the result of studies at several places, it is concluded that adequate nutrition and the

use of resistant varieties are important factors in reducing cotton-wilt losses. A balanced condition between the nitrogen and potash contents of the fertilizer was found desirable. A number of resistant varieties were discovered. Treating cotton-seed with disinfectants gave promising results at Holly Springs, Raymond, and South Mississippi Substations, but at Scott no significant differences were observed in germination, seedling diseases, or yield. Potash was beneficial in offsetting the harmful results of rust, generally causing a decrease in defoliation and an increase in yield.

645. Mildew Defects in Relation to Textile Materials. By H. Ellis. (*Text. Rec.*, xlix., Nos. 579 and 580, 1931.) A detailed account of the nature, development, and reliable methods of diagnosing the presence of mildew from apparently similar defects.

GENERAL BOTANY, BREEDING, ETC.

646. New Problems in Cotton Breeding. By I. Varuntsjan. (In Russian.) (*Khlop. Delo.*, **9**, 1930, 1026-33. Abstr. from *Plant Breeding Abstracts*, i., **4**, 1931, p. 29.) One of the new problems confronting the breeder is the production of wilt-resistant varieties, and experiments with this end in view have been started. Another essential is drought resistance so as to extend the area of cultivation. Preliminary tests have indicated that late ripening varieties are more drought resistant than the early ones commonly grown under irrigated conditions.

647. Cotton Plant: Breeding. By T. H. Kearney. (*U.S. Dpt. of Agr. Reprint No.* 1137. From *Year Book of Agr.*, 1930. Abstr. from *Summ of Curr. Lit.*, xi., **9**, 1931, p. 223.) The improvement of cotton by breeding from main types known in the past is discussed. In this way Yuma and Pima cottons were developed from Egyptian, and Meade and Acala from Upland cotton. The methods employed by cotton breeders are outlined, and it is pointed out that if the system of one-variety communities were generally adopted, the breeder might hope to see his creations perpetuated until replaced by something better, instead of disappearing a very few years after they begin to be grown commercially.

648. A Study of the Cotton Plant, with Especial Reference to its Nitrogen Content. By G. M. Armstrong and W. B. Albert. (*J. of Agr. Res.*, xlii., **10**, 1931, p. 689.) Cotton plants were grown in field plots at the Pee Dee Experiment Station, South Carolina, in 1925, 1926, and 1927, with a relatively low supply of nitrogen and with a relatively high supply of nitrogen. The concentration of nitrogen in the leaves, stalks, and fruits was generally greatest where nitrogen was relatively abundant (high-nitrogen plots), and was correlated with a greater succulence of the tissues; or conversely stated, a greater percentage of dry matter was present in the tissues of plants from plots where the nitrogen was relatively scarce (low-nitrogen plots).

The developing seed and lint from seven to twenty-one days of age showed approximately the same nitrogen concentration under high-nitrogen and low-nitrogen conditions. The boll walls and lint at later stages in 1926 showed lower concentrations of nitrogen with the low nitrogen supply. The relative proportions of the total nitrogen present in the stalks were lower in plants from low-nitrogen plots than in plants from high-nitrogen plots. The percentage of nitrogen in all tissues, except possibly seed, tended to decrease with maturity.

In 1925 and 1926 closely spaced plants had a larger proportion of stalks to total dry weight, and a larger proportion of their nitrogen in bolls than did widely spaced plants. Moreover, they absorbed a larger proportion of the total nitrogen relatively early, and in 1926 took up considerably more nitrogen.

Just prior to the rapid production of flower buds, about three-fourths of the dry weight of the plant and from 80 to 90 per cent. of the nitrogen were present in the leaves. The proportion of leaf weight to plant weight steadily declined, and the proportion of boll weight to plant weight steadily increased until the end of the fruit-setting season, when only one-fifth to one-third of the dry weight of the plant and from 30 to 55 per cent. of its nitrogen were present in the leaves. At this time from 40 to 60 per cent. of the nitrogen of the plants was found in the bolls. At twenty-one days of age, when bolls had reached full size but not maturity, approximately one-half of the boll nitrogen was present in the wall tissue. Early in the season the stalks showed an increasing proportion of the total weight, and later a gradual decline, with a decrease in the proportion of nitrogen, which was as low as 7 per cent. of the total on August 26, 1926.

The proportion of the root weight to the total weight was relatively small, ranging from 9·9 to 5·8 per cent. during the period of root collections in 1926. The proportion of the total nitrogen was even less, ranging from 4·1 to only 1 per cent.

The total quantity of nitrogen absorbed by the plants early in the season was not large, although the rate of absorption was very rapid owing to the increase in size of the small plants. Under certain seasonal conditions, however, such as prevailed in 1926, older plants absorbed from 40 to 50 per cent. of the nitrogen of the crop, equivalent to several hundred pounds per acre of nitrogen as nitrate of soda, in about two weeks.

649. THE IMMEDIATE EFFECT OF ARTIFICIAL SELF-FERTILIZATION ON SOME ECONOMIC CHARACTERS OF THE COTTON PLANT. By C. Jagannatha Rao. (*Madras Agr. J.*, **19**, 1931, p. 113. Abstr. from *Plant Breeding Abstracts*, i., **4**, 1931, p. 4.) A certain number of flowers were artificially selfed, and the remaining ones left free to natural pollination. The flowering and bolling curves showed no appreciable differences between the two lots, and no differences were observed in respect of the following boll characters: ovules per lock, seeds per lock, fertility index, lint length, kapas weight per seed, lint weight per seed, seed weight, and ginning percentage.

650. THE ORDER, RATE, AND REGULARITY OF BLOOMING IN THE COTTON PLANT. By C. K. McClelland and J. W. Neely. (*J. of Agr. Res.*, xlii., **11**, 1931, p. 751.) Cotton exhibits a greater or less tendency toward regularity in its blooming. The regularity is interrupted by many different causes, and the rate is influenced by variety, seasonal conditions, location, cultural methods, and possibly other factors. The intervals between the appearance of successive fruiting branches and the appearance of successive squares, as determined by other investigators, show a close similarity to the intervals between blooms in a vertical and horizontal direction as indicated in the present paper. A cyclic tendency in blooming in grouped plants is due to the tendency toward regularity in the individual plants. That the breaks in the flowering curves are not regular and pronounced is due (1) to conditions which upset the regularity in the individual plants, (2) to the fact that these plants begin blooming on different dates, and (3) to injuries and shedding, which to some extent modify results. The horizontal interval of blooming varies on an average less than 0·4 from a six-day interval, and consistently increases at outer nodes of fruiting branches over the intervals found between nodes nearer the central stem. In other words, the early intervals are shorter than the later ones. The average for vertical order of blooming is in very few instances outside the range 2·3 to 2·8 days. Usually the vertical interval decreased at the outer nodes, since blooms occurred at such nodes only on the earlier or lower fruiting branches, and were a product of the vigorous growth of the plants. The ratio between the horizontal and vertical intervals,

though varying greatly, was in most instances between 2·6 and 2·1. To be strictly regular this ratio, it would appear, must be exactly 2, but the vertical intervals have been unduly shortened, increasing the ratios. A study of the data of all workers shows but slight differences in the rapidity of blooming of cotton, due to difference in species, variety, altitude, latitude, season, or various cultural practices. To make cotton " bloom fast " is almost impossible, but the number of blooms per plant or per row or per day can be increased by increasing the size of the plant. The plants that produce 75 to 100 blooms will show so-called faster rates of blooming than plants that produce 20 to 30 blooms.

651. EARLY DEFLORATION AS A METHOD OF INCREASING COTTON YIELDS, AND THE RELATION OF FRUITFULNESS TO FIBRE AND BOLL CHARACTERS. By F. M. Eaton. (*J. of Agr. Res.*, xlii., 8, 1931, p. 447.) An experiment was conducted in Arizona with the Acala Upland and the Pima Egyptian varieties of cotton, for the purpose of determining (1) whether yields could be increased by delaying for several weeks the initiation of flowering and boll setting, and (2) the effect of both an increased and a decreased number of bolls per plant upon the characteristics of the bolls and fibre produced.

The modifications in the number of bolls per plant were brought about in two ways: (1) By allowing a boll to develop only at the first node of any fruiting branch, and (2) by removing all flowers during the first twenty-five days of the flowering period. The results of these treatments were checked against the number of bolls produced by untreated control plants. The resultant yields in number of bolls per plant were: For Acala, 10·7 and 20·1 from 1-boll-per-branch and early-deflorated plants, respectively, as against 16·8 from untreated plants; and for Pima, 16·6 and 49·9 from 1-boll-per-branch and early-deflorated plants, respectively, as against 42·4 from untreated plants. While the effect of the first treatment was to decrease the number of bolls, substantially increased yields resulted from the second treatment (early defloration) in both varieties, irrespective of whether the yields were measured in terms of the number of bolls, the weight of the seed cotton, or the weight of the fibre produced.

An increase of more than 24 per cent. in the yield of Acala cotton was obtained in a supplementary experiment in which all bolls and flowers and the larger squares were stripped from 100 plants alternately spaced with control plants. The plants were treated in this manner on the eighth day of the flowering period, and they again produced flowers fourteen days later. The method used in this experiment may prove practicable commercially, and the increased yields obtained from it indicate that it might be profitable.

An inverse relation was found, in both Acala and Pima, between the numbers of bolls per plant and the mean weights of the open bolls and burs, and of seed cotton per boll and seed per boll (also Pima fibre per boll) for the bolls resulting from the second-period flowers (August 5 to 22). It was not until the latter part of the summer that the early deflorated Pima plants had set a greater number of bolls than the control plants, and, in the characters mentioned above, the early-deflorated Pima plants were intermediate between the 1-boll-per-branch and the control plants. In general the weight of the burs was influenced by the treatments to a greater extent than the weight of the seed cotton, and the weight of the seed more than the weight of the fibre.

The treatments did not result in significant differences in the number of locks per boll, nor did they materially influence boll-maturation period.

The classification of the Acala cotton from the second-period flowers brought out differences which favoured the fibre from the 1-boll-per-branch and the control plants. In samples representing both pickings from the supplementary Acala experiment, the only differences were in the number of neps; fewer neps were found in the samples from plants stripped of early bolls and buds.

The cotton from Pima 1-boll-per-branch plants received the highest ratings, that from the early-deflorated plants being intermediate, and that from the control plants lowest.

It has been observed that the yields of determinate strains of cotton are lower than the yields of strains that ordinarily abort a considerable number of their early buds and bolls. The Acala strain used in experiments herein reported has proved to be less determinate in its growth and better suited to Arizona conditions than other strains with which it has been compared.

The marked increase in yields obtained by early defloration is particularly noteworthy in view of the fact that similar results were obtained with both the Acala Upland and the Pima Egyptian varieties, which are very different, not only in their morphological, but also in many of their physiological characteristics.

652. Changes in the Sugar, Oil, and Gossypol Content of the Developing Cotton Boll. By C. Caskey and W. D. Gallup. (*J. of Agr. Res.*, xlii., **10**, 1931, p. 671.) The sugar, oil, and gossypol content of cotton bolls at different stages of maturity was determined. Both gossypol and oil increased rapidly in the seed from the twenty-first day until the thirtieth day. The gossypol increased more rapidly than the oil, and continued to increase slowly until the boll was fifty days old and fully matured. The sugars in all parts of the boll decreased gradually during the thirty-day period of growth.

653. Metaxenia in Cotton. By G. J. Harrison. (*J. of Agr. Res.*, xlii., **9**, 1931, p. 521.) Experiments to determine whether metaxenia, or immediate effects of pollen on tissues of the mother plant, occurs in cotton were suggested by the discovery of this phenomenon in the date palm by Swingle and Nixon. The first experiment involved two different types of cotton, Pima Egyptian and Hopi. These forms represent the two main groups of New World cottons, the Pima belonging to the South American group, and Hopi to the Mexican-Central American group. Flowers on some of the Pima plants were fertilized with Hopi pollen, while flowers on other Pima plants were left to natural pollination. The boll period, or number of days from anthesis to opening of the boll, was computed from a record of each individual boll. Determinations of length of lint, lint index, seed fuzziness, number of seeds per boll, and weight of the individual seeds were made on approximately 100 bolls from each fertilization. The lint lengths of Pima and Hopi average about $1\frac{5}{8}$ and $\frac{7}{8}$ in. respectively. A significant reduction in length of lint of a full $\frac{1}{16}$ in. resulted from fertilization of Pima flowers with Hopi pollen.

A second experiment involved Pima Egyptian, Durango Upland, and Hopi. The lint length of Durango averages $1\frac{1}{4}$ in. The boll period of Durango averages longer than that of Hopi, but much shorter than that of Pima. The characters studied were the same as in the first experiment, except seed fuzziness, which was disregarded because of the extreme fuzziness of Durango seeds. The mean boll period on Durango plants was slightly but significantly increased by fertilization with Pima pollen, as compared with fertilization by Durango and by Hopi pollen. Pollen of the longer-linted Pima variety lengthened the lint of the intermediate Durango variety, and pollen of the Hopi variety shortened it.

Reciprocal cross-pollinations of Pima Egyptian and Acala Upland cottons, the varieties most extensively grown in the Salt River Valley, Arizona, gave results in agreement with those of the earlier experiments. The time required for maturation of the boll was significantly decreased when Pima flowers were fertilized with Acala pollen, and was significantly increased when Acala flowers were fertilized with Pima pollen. The lint length was significantly decreased when Pima flowers were fertilized with Acala pollen, and significantly increased

when Acala flowers were fertilized with Pima pollen. In both cases the difference, in comparison with the lint length from fertilization with like pollen, averaged slightly more than $\frac{1}{16}$ in.

The theory advanced by Swingle, which attributes metaxenia in the genus Phœnix to a hormone-like action of substances secreted by the embryo or the endosperm, seems to account equally well for the results obtained in Gossypium.

The metaxenia effect on length of lint suggests the danger of growing two or more varieties of cotton of widely divergent staple lengths in the same vicinity, as the uniformity of both products is likely to be impaired to the extent that cross-fertilization occurs.

654. WORK ON ARTIFICIALLY INDUCED MUTATIONS IN COTTON IN THE PLANT BREEDING DIVISION OF THE N. I. KH. I. By V. Bel-Kuznjetcova. (*Bull. Sci. Res. Cott. Inst.*, Tashkent, **5**, 1930, p. 18. Abstr. from *Plant Breeding Abstracts*, i., **4**, 1931, p. 30.) A brief discussion of induced mutations and their value in plant breeding. The fact that this affords means of creating new characters rather than recombinations of old ones led the division to undertake experiments with X-rays, radium, low temperature, and narcotics, on cotton seeds and flowers.

The following investigations are in progress at the station: The influence of various agencies, of which there are forty-seven variants under investigation, on the dry cotton seed, on swelling seeds, on seeds of seven commercial varieties, on germinating seeds previously soaked in salts of lead and iron; X-ray treatment of thirty-two lines representative of different botanical groups. The action of the various agencies on the flowers in various stages of development is also being examined. The cotton plant displays a greater tolerance of these agencies than many plants.

655. PLANT CELL MEMBRANES: STRUCTURE. By M. Lüdtke. (*Biochem. Z.*, **233**, 1931, p. 2. Abstr. from *Summ. of Curr. Lit.*, xi., **13**, 1931, p. 370.) The structure of plant tissues is described, and the occurrence of cellulose and lignin and the existence of various membrane systems are discussed. The available evidence indicates that there is no chemical combination between lignin and cellulose in the plant, and that the substance forming the membranes, although similar to lignin in many properties, is not identical with lignin. Various theories of the constitution of the polymeric carbohydrates and the processes by which they are synthesized from simple sugars in plants are reviewed, and the most probable mechanism is outlined. Methods for the quantitative determination of cellulose and the detection and isolation of the intermediate products in the formation of cellulose and xylan are described.

656. NATURE AND SIGNIFICANCE OF STRUCTURAL CHROMOSOME ALTERATIONS INDUCED BY X-RAYS AND RADIUM. By T. H. Goodspeed and P. Avery. (*Cytologia*, **1**, 1930, pp. 308-27. Abstr. from *Papers on Plant Genetics*, i., **2**, 1930, p. 14.) The gene mutations induced artificially have led to the suggestion that natural radiation represents a major factor in the evolutionary mechanism. The various types of chromosome irregularities which may result from irradiation are described and illustrated in some detail. Many of the morphological and other variations arising from irradiation are ascribed to these chromosome irregularities, others appear to be definitely gene mutations.

657. THE PRODUCTION OF HOMOZYGOTES THROUGH INDUCED PARTHENOGENESIS. By E. M. East. (*Science*, **72**, pp. 148-9, 1930. Abstr. from *Papers on Plant Genetics*, i., **2**, 1930, p. 14.) A number of diploid plants obtained from wide crosses were pure for the characters expected in the female gametes. They must have arisen by parthenogenesis from haploid cells during the development of which diploidy ensued. They were therefore completely homozygous. If this

method of producing homozygotes can be applied to other plants, it will be of great practical importance.

658. GERMINATION OF COTTON POLLEN IN ARTIFICIAL CULTURE MEDIA. By T. Shibuya. (*J. Soc. Trop. Agr.*, **2**, 1930, pp. 55-64. Abstr. from *Papers on Plant Genetics*, i., **2**, 1930, p. 29.) The germination of pollen grains on agar-agar with sucrose of varying concentrations was examined. The most favourable concentration proved to be 35 or 40 per cent. sucrose plus 5 or 4 per cent. agar. Temperature and pH effects were also noted.

FIBRE, YARN, SPINNING, WEAVING, ETC.

659. CURRENT CHANGES IN THE TECHNOLOGY OF COTTON SPINNING AND CULTIVATION. By W. L. Balls. (*J. of Text. Inst.*, Coming-of-Age Celebrations Rpt., xxii., **5**, 1931, p. 52.) Dr. Balls states that economic pressure on the one hand, and scientific method on the other, interact to a greater extent than is commonly realized, and the increased importance of the research laboratories has been partly due to changes taking place in the industries themselves, and to the comparative cheapness of technical research.

It is expected that cotton production will concentrate on the higher qualities, and the inferior kinds of cotton are looked upon as probable victims to artificial silk.

The author points out the great importance of Johannsen's theory of " pure lines," and describes his own efforts to bring into use the method of formulating cotton problems in terms of the single cotton hair. Many other matters are dealt with in this very interesting lecture, including speculations and suggestions concerning the future.

660. TEXTILE MICROSCOPY: NEW DEVELOPMENTS. By E. R. Schwarz. (*Melliand*, ii., **10**, 1931, p. 1342. Abstr. from *J. of Text. Inst.*, xxii., **7**, 1931, A350.) A survey of microscopical research in textiles, with regard to fundamental investigation, applied research, and pure science. Developments in equipment and technique are reviewed, and the interpretation of data considered.

661. TEXTILES: INDUSTRIAL APPLICATIONS. (*Text. World*, **79**, 1931, p. 598, Abstr. from *J. of Text. Inst.*, xxii., **7**, 1931, A369.) A series of short reviews of the use of textiles in aviation, radio, sound pictures, etc., in the automobile machinery, electrical, chemical, and allied fields, among rubber manufacturers and general manufacturers, in the footwear, luggage, coal and food industries, and in electric railways, by editors of the respective trade journals.

662. THE USE OF THE MICROSCOPE IN THE TEXTILE INDUSTRY. X. THE POLARISATION MICROSCOPE. By J. M. Preston. (*J. of Text. Inst.*, xxii., **6**, 1931, A312.) Although the size of the cellulose micelle has been determined, its dimensions are too small to be observed directly by the microscope, and the ultra-microscope cannot distinguish the images of the micelles as separate entities. The micelles of cellulose have been shown to be in the form of monoclinic crystals, which have different properties in different directions. In this connection, the refractive index and its determination are discussed. The method of determining in which direction the micelles are lying is described, the fibre being examined between a polariser and analyzer, arranged with their planes crossed at right angles to each other.

663. COTTON DOUBLING AND TWISTING. By S. Wakefield. (Pubd. C. Nicholls and Co., Ltd., Manchester. Abstr. from *J. of Text. Inst.*, xxii., **6**, 1931, p. 116.) This is the second edition of a very well-known work in four volumes first published in book form in 1915. It gives a very good general description of the

machinery, appliances, and methods employed in that large and increasingly important branch of the cotton trade which is responsible for the production of almost all the varied types of doubled yarn required by the manufacturer and finisher. The subject matter, which is amply illustrated, is well arranged and dealt with in a clear and concise manner, and each section is adequately indexed.

Vol. I.: Section I., Yarn Testing and Sampling. Section II., Double Winding.

Vol. II.: Section III., Flyer and Ring Twisting. Section IV., Twiner twisting.

Vol. III.: Section V., Clearing and Gassing. Section VI., Reeling, Preparing, and Making-up.

Vol. IV.: Section VII., Threads and their Manufacture. Section VIII., Costs, Waste, and Organization.

664. COTTON YARN: COSTING. Cotton Text. Inst. Inc., New York. (*A Method of Predetermining Costs in Cotton Yarn Mills*, 1930, p. 47. Abstr. from *Summ. of Curr. Lit.*, xi., **9**, 1931, p. 254.) An account is given of a fully tabulated system of costings based on the working of an imaginary mill assumed to be operating fifty-five hours weekly, employing 25,000 spindles, and making various counts ranging from 8's to 2/30's to be delivered in cone, tube, skein, or ball warp form. The figures are not intended to be regarded as ideal, having been set up solely for the purpose of demonstrating methods of cost finding.

665. BALE BREAKER. By Saco-Lowell Shops. (*Text. World*, **79**, 1931, p. 1000. Abstr. from *J. of Text. Inst.*, xxii., **7**, 1931, A331.) A new bale breaker departs from previous designs in the arrangement of the doffer, the pin cylinder, and the doffer bonnet. A radical change of construction permits instant dismounting of the doffer bonnet by separating two hinges which hold it in place over the doffer. By simply raising the bonnet the doffer and pin apron are immediately accessible for adjustment or inspection. When the bonnet is removed the doffer can be lifted out, bringing the entire section of the machine within easy reach of the attendants. When chokes occur the machine can be cleared instantly by raising the bonnet. Cotton matted on the lifting apron may be removed, or the galvanized mount cleared out. The motor is mounted much lower on the frame than before to facilitate oiling and inspection. A baffle plate on the front of the hopper section prevents passage of dust into the room.

666. COTTON OPENING AND SCUTCHING MACHINE. By J. Forkin. (Bury.) E.P.341,617 of November 15, 1929. Abstr. from *J. of Text. Inst.*, xxii., **6**, 1931, A296.) A lattice feeds the material to a pair of feed rollers from which it is drawn by a second pair of feed rollers, rotating faster than the first pair, and presented to a rotary cylinder having peripheral saw teeth. Adjustable plates with concave faces co-operate with the cylinder and provide spaces, through which dirt, etc., can fall, between themselves, the second pair of feed rollers, and a stationary flat mounted beneath the cylinder. The flat is provided with card clothing secured to a slide detachably mounted in a member which rests on adjusting screws. Suction cages remove the fibres and pass them on to calendering rollers, whilst dirt, etc., is sucked past dirt bars up an air trunk. A deflector blade prevents any accumulation of dirt and fibres on the saw teeth.

667. COTTON PROCESSING MACHINERY: LUBRICATION. By L. A. Baudoin. (*Melliand*, **2**, 1930, p. 1216. Abstr. from *J. of Text. Inst.*, xxii., **6**, 1931, A321.) A general article. A table is included showing the lubricating frequency, cleaning period, and lubricating material advisable for the various types of opening, spinning, weaving, and finishing machines.

668. FINE STAPLE TESTER. By L. Deltour. (*Rev. Text.*, **29**, 1931, p. 313. Abstr. from *Summ. of Curr. Lit.*, xi., **11**, 1931, p. 307.) Apparatus for the deter-

mination of the mean length of a bundle of fibres is described. The fibres are gripped at one end by fixed jaws and smoothed out by hand, so that the other ends lie over a table provided with a scale by means of which the length of the longest fibres may be estimated. A cutting device consisting of two knives separated by a distance of 20 mm. is forced down over the fibres near the fixed jaws to cut out a section of 20 mm. length from each fibre. At the same time a second pair of jaws moves out from the first, maintaining a uniform tension over the fibres during the cutting process. The sections are collected and attached to a hook on one side of a special sensitive balance, while the remainder of the fibre bundle is suspended from the other side of the balance beam. The scale is graduated to give the mean length directly in millimetres. The theory of the method is explained in detail, and a method of obtaining a schematic representation of staple diagrams from a knowledge of the maximum, minimum, and mean lengths is described.

669. Automatic Looms. (*Scotch Tweed*, **8**, 1930, p. 115. Abstr. from *J. of Text. Inst.*, xxii., **6**, 1931, A299.) A Continental correspondent describes an installation of six new automatic looms made in Chemnitz, Saxony. They can weave pick-and-pick on a very simple principle. The arrangement is similar to what was previously in vogue, but the main difference is that the second box is a dummy, and when contact is made on the metal collar of the pirn in the top shuttle, the new pirn knocks the empty one into the second box, from which it falls into the box collecting empties. The loom performs exactly as an ordinary loom, working 1-and-1 with three shuttles, but instead of boxes 1 and 2 working to boxes 1 and 2, boxes 1 and 3 work to 1 and 2. The loom is fitted with a Knowles dobby, open shed, positive let-off and take-up, 100 shots per minute.

670. Automatic Looms: Application. (*Spinn. u. Web.*, xlix., **16**, 1931, p. 1. Abstr. *Summ. of Curr. Lit.*, xi., **31**, 1931, p. 359.) Discusses the following: The types of weaving for which automatic looms are suitable; Vomag automatic looms for special purposes; some of the problems arising in the replacement of ordinary looms by automatic looms.

671. Automatic Weft Replenishment Loom. Soc. Alsacienne de Constructions Mecaniques, Mulhouse, France. E.P.344,805 of March 7, 1929. Abstr. from *Summ of Curr. Lit.*, xi., **12**, 1931, p. 336.) The patent relates to a loom of the kind in which, on exhaustion of weft, the loom is stopped, a separate shuttle-changing mechanism is put in operation, and the loom is restarted.

672. Cotton Seed Fuzz: Use as Rayon Raw Material. By P. H. Minck. (*Kunstseide*, **13**, 1931, pp. 97-8. Abstr. from *Summ. of Curr. Lit.*, xi., **10**, 1931, p. 255.) "Minck" fibre, the short fibre remaining on the cotton seed after the removal of the lint and linters, may be removed by means of a special defibrator. A standard quality containing over 90 per cent. pure cellulose, suitable for the manufacture of rayons, can readily be obtained. It is suggested that this new product might displace cotton linters, and that eventually only the first 40 lb. of linters per ton, which is used in the manufacture of mattresses, will be removed as such from the seed.

673. Immunized Cotton—I. By C. E. Mullin and R. L. McGee. (*Text. Rec.*, xlix., **578**, 1931, p. 59, and **579**, p. 59.) A review of the literature upon the immunization of cotton to direct cotton, sulphur, vat, and similar dyestuffs.

The first paragraph states that "immunized cotton is cotton which in some form has been treated by a chemical process so as to render it immune to dyeing by any of the dyestuffs generally used in dyeing ordinary cotton. This immunization process consists of forming an ester of cellulose in or on the fibres. There are now several processes of immunization." This cotton is principally

used in the hosiery and knit-goods trade, for white and two-colour effects in dyed goods. Upon dyeing the results are similar to those obtained by the use of acetate rayon.

674. Mill Wastes. By J. Chittick. (*Text. Rec.*, xlix., **580**, 1931, p. 26.) Discusses the wastage of textile material in mills, and indicates how waste products can be made commercially valuable.

675. A New Use for Cotton. (*Trop. Life*, July, 1931, p. 126.) Mr. N. S. Pearse, Secretary of the International Federation of Master Cotton Spinners and Manufacturers Associations, states that, as a result of experiments carried out during recent months by the Federation with the object of producing a cotton cloth suitable for letter paper, suitable cloths of different qualities and prices have now been placed on the market competitive with most qualities of letter heads manufactured from paper. There are many decided advantages in favour of cotton cloth as against paper. It will take pen ink, printing ink, and typewriting just as well as paper, but typists' errors are much more easily erased on cloth than on paper. The appearance and feel of the cloth paper is far superior to that of paper at the same price, and it is certainly far more durable. Four good carbon copies are obtainable through cloth, and press copies may also be taken. It is interesting to note that Manchester and London business houses and cotton firms on the Continent and in Egypt are ordering trial lots of this new stationery.

LEGISLATION.

676. America. *Regulations of the Secretary of Agriculture under the United States Cotton Standards Act.* "Service and Regulatory Announcements No. 125, of 27th April, 1931." The regulations deal with the following: Administration, Requests for Classification and Comparison, Submission and Disposition of Samples, Classification, Sample or Type Comparison, Certificates and Memoranda, Reviews and Appeals, Supervision of Transfers of Cotton, Licensed Classifiers, Official Cotton Standards, Fees and Costs, American Cotton Linters, Adjustment of Disputes, Publications.

Regulations of the Secretary of Agriculture under the United States Cotton Futures Act. "Service and Regulatory Announcements No. 124, of 27th April, 1931." The regulations deal with the following: Administration, Classification Requests, Inspection and Samples, Cotton Class Certificates, Delayed Certification, Reviews, Supervision of Transfers of Cotton, Costs of Classification and Certificates, Spot Markets, Price Quotations and Differences, Official Cotton Standards, Publications.

677. Australia. *Statutory Rules No.* 105, September 12, 1930. Give the regulations governing the payment of bounties for seed cotton, lint, and cotton yarn.

678. Fiji. *Noxious Weeds and Diseases of Plants Regulations,* 1930. (*Fiji Royal Gazette No.* 64, November 14, 1930.) Part IV., dealing with the regulations for the prevention of the spread of cotton diseases, states that the Director of Agriculture may fix dates for destruction of cotton plants, ratooning of cotton plants, and planting of cotton seed.

679. Tanganyika. *Government Notice No.* 177, of October 31, 1930, gives the regulations governing the importation of plants and seeds into the Territory and the fees payable for any inspection, disinfection, or treatment required.

TRADE, CO-OPERATION, ETC.

680. LANCASHIRE COTTON GOODS: EXPORTS. By W. H. Slater. (*Text. Weekly*, 7, 1931, pp. 39-40 and 134-135. Abstr. from *Summ. of Curr. Lit.*, xi., **10**, 1931, p. 290.) The following tables of data are given: (1) Exports of cotton goods under main classes, in yards and values, from 1913-1920. (2) Exports of piece goods under main markets, in linear yards. (3) Exports of piece goods to India, under main classes, in quantities and values and percentages of exports to the whole world. (4) Indian home production and imports from Great Britain and from Japan, in yards, and the values of Indian import duties. (5) Percentages of Indian piece goods markets shared by India, Great Britain, and Japan.

681. COTTON PIECE GOODS: EXPORTS TO THE FAR EAST. By W. H. Slater. (*Text. Weekly*, 7, 1931, p. 308. Abstr. from *Summ. of Curr. Lit.*, xi., **13**, 1931, p. 379.) Tables are given showing the importance of the Far Eastern market compared with the total world, British exports of cotton piece-goods to China and Hong Kong, and imports of cotton piece-goods and yarns into China during recent years.

682. COTTON GOODS: EXPORTS TO SOUTH AMERICA. (*Text. Weekly*, 7, 1931, p. 341. Abstr. from *Summ. of Curr. Lit.*, xi., **13**, 1931, p. 379.) Trading conditions in the Argentine, Brazil, Uruguay, and Chile are reviewed, and tables of data are produced. These show yardage, values, varieties, and countries of origin for the last four or five years.

683. COTTON GOODS: PRICE ANALYSES. By W. H. Slater. (*Text. Weekly*, 7, 1931, pp. 198-9. Abstr. from *Summ. of Curr. Lit.*, xi., **10**, 1931, p. 290.) Taking 1913 as the basis for prices (=100), the author has tabulated index numbers of raw cotton, yarn, and piece-goods prices from 1920 to 1931 (March), and compared them with the Board of Trade index numbers for "all cottons" and for "all wholesale prices." The result of the analysis indicates that the price of piece goods is still 17 per cent. above the level of all wholesale commodities, although the price of American and Egyptian cotton and yarn is well below this level.

684. RAW COTTON: BUYING IN LIVERPOOL. (*Text. Weekly*, 7, 1931, p. 38. Abstr. from *J. of Text. Inst.*, xxii., 7, 1931, A367.) A description of the procedure followed by a spinner and his broker on the Liverpool "spot" market.

MISCELLANEOUS.

685. ABSTRACTS OF PAPERS ON AGRICULTURAL RESEARCH IN THE UNITED KINGDOM (1929-30). (Obtainable Min. of Agr. and Fisheries, London. Price 1s. net.) A continuation for 1929-30 of a volume prepared for the Imperial Agricultural Research Conference, 1927. The papers abstracted have been limited to those dealing with results or methods of research work in agriculture, and the abstracts have been made by the investigators themselves. Four Appendices are included: (1) List of Government Departments, research institutes, advisory centres, etc., contributing the abstracts; (2) index of authors of abstracts; (3) list of abbreviations of titles of periodicals used in the volume; (4) index of subjects.

686. REPORTS ON THE WORK OF AGRICULTURAL RESEARCH INSTITUTES AND ON CERTAIN OTHER AGRICULTURAL INVESTIGATIONS IN THE UNITED KINGDOM, 1929-30. (Min. of Agr. and Fisheries, London, 1931.) Contains summaries of the work in progress at Agricultural Research Institutes in the United Kingdom and Northern Ireland. An Appendix to the volume gives the names and addresses of Directors of Research Institutes and persons in charge of investigations at other centres.

687. THE DISSEMINATION OF RESEARCH RESULTS AMONG AGRICULTURAL PRODUCERS. (*E.M.B.*, 33, 1930. Pubd. H.M. Stat. Off. Price 1s. net.) We have recently received a copy of this valuable report, which contains the answers to a questionnaire issued by the Empire Marketing Board to all Empire Governments, with a view to discovering how the results of scientific investigations are in various countries disseminated among the primary agricultural producers. A most interesting introduction to the report is contributed by Sir Daniel Hall, and a great deal of useful information is contained in the replies to the questionnaire, relating to such matters as the testing of scientific results under local conditions; visits to experimental farms; agricultural education and instruction; duties of agricultural instructors; the extent to which co-operative societies influence the dissemination of scientific knowledge; the value of agricultural journals, etc.

688. SCIENCE OF THE YEAR 1930: THE BIOLOGICAL SCIENCES. By W. B. Brierley. (Reprint recd. from Dpt. of Mycology, Rothamsted Exp. Sta., 1931.) An interesting account of the general process of biological science during the year, given under the following heads: Evolution and Genetics, Zoology, General Physiology, Botany, Microbiology, and Disease.

689. LANCASHIRE. In a Supplement to the *Man. Guar. Coml.* of July 2 is assembled an excellent collection of information, covering the wide range and scope of Lancashire industrial activity. Among the articles included in the Supplement are the following: " Lancashire of the Future," T. D. Barlow; " Lancashire of the Past," Dr. A. Redford; " What Cotton Means to Lancashire," and " Lancashire's Part in the Rayon Industry."

690. THE LIVERPOOL COTTON MARKET. By R. G. Wood. (*Trop. Agriculture*, viii., 8, 1931, p. 210.) An interesting article on the working of the Liverpool Cotton Market, in which the following terms and phrases are explained: " Futures," " Middling " prices; " Straddles," " Hedge selling," " Near and Distant " months; " Seller's call "; " An Only "; " Longs and Shorts "; " Jobbers."

691. RAW COTTON: PRODUCTION AND DEMAND, 1931-32. Bureau of Agr. Economics. (*U.S. Dpt. Agr. Misc. Pub. No.* 104, 1930. Abstr from *Summ. of Curr. Lit.*, xi., 13, 1931, p. 379.) An analysis of the demand for cotton in the United States, Great Britain, various European countries, Russia, Japan, China, and India, and the supply of cotton in the United States, India, China, Egypt, Russia, and other cotton-producing countries. Crops and statistics are given. Costs of production, staple lengths, prices, distributions and carry-overs are studied, and the cotton outlook for 1931-32 and long-time outlook for agriculture in the Southern States are discussed.

692. TECHNICAL EDUCATION FOR THE TEXTILE INDUSTRY. By A. Abbott. (*J. of Text. Inst.*, Coming-of-Age Celebrations Rpt., xxii., 5, 1951, p. 64.) Deals with the subject under the following heads: The General Question of Technical Education; Influence of Scientific Research Associations; Essential Managerial Qualifications; Requirements for General Technical Training; Developments in Textile Technical Education.

693. THE WORLD COTTON SITUATION, WITH OUTLOOK FOR 1931-32, AND THE LONG TIME OUTLOOK FOR SOUTHERN AGRICULTURE. (*U.S. Dpt. Agr. Misc. Pubn.* 104, 1930. Abstr. from *Exp. Sta. Rec.*, lxiv., 8, 1931, p. 784.) Charts are presented and discussed showing for periods of years the total domestic and foreign demands; the demands in Europe and Asia; world supply and the supply in the United States, India, China, Egypt, and Russia; prices, staple length, production, distribution, and carry-over of American cotton; domestic consumption of long-staple cottons; staple length of foreign cotton; cost factors in cotton production in the United States, etc.

ADDENDA.

694. THE INTERNATIONAL COTTON CONGRESS, 1931. (*Int. Cot. Bull.*, ix., **36**, 1931.) The Fifteenth International Cotton Congress, held in Paris in June last, was officially opened by Monsieur Lainel, Chief of the Cabinet of the Minister of Commerce, in the absence on urgent state business of Monsieur Louis Rollin, Minister of Commerce. Over 500 delegates from twenty countries attended the Congress.

Responding to the official welcome, Count Jean de Hemptinne, president of the International Federation, spoke on the activities of the Federation since the previous Congress held at Barcelona twenty-one months ago.

The first day's proceedings were concerned with the following matters connected with Egyptian, American, and Indian cottons: The work accomplished by the Joint Egyptian Cotton Committee since the last Congress; the classification, humidity, and packing of American cotton; the impurities in Indian cotton, and the mixing of Punjab-American cotton.

The causes of the world-wide depression in the cotton industry, and suggested remedies, formed the main subject of discussion on the second day. A number of interesting papers were read, and will be found in the *Int. Cot. Bull.*, vol. ix., August, 1931.

The last day of the Congress was occupied in passing the various resolutions drafted as the result of the discussions at the previous meetings.

695. REPORT ON THE WORK OF THE INDIAN TRADE COMMISSIONER DURING 1930-31. By H. A. F. Lindsay. This report is of the usual informative nature. An interesting chapter is again included on Modern Trade Tendencies; other chapters deal with Markets for Indian Timbers and Minerals; Agricultural Products—Foodstuffs and Industrial Materials; Trade Publicity—Exhibitions and Fairs, Lectures, Exhibits, and Enquiries.

The improvement in the trade in Indian cotton noted in last year's report has not been maintained so far as Europe generally is concerned. The United Kingdom increased her imports by some 2,000 tons, but Italy and Germany, the next largest buyers, both reduced their purchases. The general decrease in exports of raw cotton from India is due partly to the larger local demands and partly to the world trade depression.

During the year the Liverpool Cotton Association introduced a new form of contract for East Indian cotton based on superfine C. P. Oomra cotton (of no less staple than Oomra No. 1). This decision was received with much satisfaction in India, and it is hoped that the trade in Indian raw cotton with the United Kingdom will further increase in consequence.

696. MEMOIRS OF THE COTTON RESEARCH STATION, TRINIDAD. (Pubd. by the Empire Cotton Growing Corporation. Price 2s. 6d. post free.) The second number of Series A, Genetics, has recently been issued, and contains the following paper reprinted from the *Jour. of Genetics*:

"The Genetics of Cotton. Pt. IV. The Inheritance of Corolla Colour and Petal Size in Asiatic Cottons." By J. B. Hutchinson. The data here presented are the result of the second part of an investigation into the inheritance of corolla colour and associated characters in *Gossypium*. The first part, dealing with the New World species of *Gossypium*, was published by Harland in 1929. [*Cf.* Abstr. 676, Vol. VI., p. 382 of this Review.] The present paper is concerned with the Asiatic *Gossypiums*, among which corolla colour ranges from deep yellow to ivory white, forming a colour series very similar to that described by Harland for the New World *Gossypiums*. In previous work in India, Leake and Ram

Prasad have demonstrated single-factor differences between yellow and pale, and between yellow and white, and Kottur has confirmed the existence of a single-factor difference between yellow and white. Kottur has observed a pale dominant to full yellow. Fyson, Leake, and Kottur have all demonstrated a very close correlation between petal size and corolla colour.

In this paper evidence is presented to show: (1) That yellow, Leake's pale, and white form a multiple allelomorph series, which is designated Y, Yp, and y; (2) that the correlation between petal size and corolla colour holds good for minor factors which affect corolla colour as well as for the main multiple allelomorph series; (3) that plants with yellow flowers and short petals, and white flowers and long petals occur as a result of the shuffling of these modifying factors and not as a result of crossing-over, and that these yellow short-petal types are lighter in colour than yellow long-petal types, and are similar to Kottur's pale; (4) that there is a physiological relationship between colour and size. Evidence is also presented to show that both main and minor corolla-colour factors affect lint characters as well as petal size.

PERSONAL NOTES

It was with much regret that the Corporation learned of the tragic death of Mr. Raymond H. K. Peto in the recent mountaineering accident in Switzerland. Mr. Peto held an appointment under the Corporation as Assistant Chemist at Wad Medani, Sudan, from 1927 until last year, when he was absorbed into the service of the Sudan Government.

APPOINTMENTS.

South Africa.

Mr. H. Hutchinson has been transferred to Barberton to assist Mr. Parnell at the Cotton Breeding Station.

Nigeria.

Mr. A. E. Casement has been appointed to succeed Mr. Hutchinson as Assistant to Mr. Browne at Daudawa.

STUDENTSHIPS.

The Studentships awarded last year to B. R. Jones and D. F. Ruston have been confirmed for a second year, and will be tenable at the Imperial College of Tropical Agriculture, Trinidad.

Studentships have also been granted to E. J. Butler, J. Marshall, E. J. M. Shearer, and N. M. Wight, and will be tenable for the first year at Cambridge University.

The following holders of Studentships last year have received appointments as under: W. L. Fielding, E. O. Pearson, and M. F. Rose have been appointed by the Corporation as Assistants to Mr. Parnell at the Cotton Breeding Station, Barberton. W. J. M. Irving and J. D. Jameson have secured posts in the Colonial Agricultural Service in Uganda. Mr. Jameson will first receive some specialized training at Barberton during the coming cotton season before proceeding to Uganda to take up his post there.

OFFICERS ON LEAVE.

When an officer of a colonial Department of Agriculture (or of the allied departments of Irrigation, Transport, etc.) comes "home" on leave, he usually brings with him much information that may be of considerable value to similar officers in other colonies, or to the officers of the Empire Cotton Growing Corporation, who have to collect, collate, and use all possible information relating to cotton. The Corporation would consequently much appreciate the courtesy if Directors of Agriculture and others would be so kind as to inform them, in advance if possible, of the names, probable addresses, and approximate dates of arrival in England of officers coming on leave. This would give the Corporation the opportunity of getting into touch with these officers themselves, and of giving the latter the opportunity of meeting with one another. A further courtesy would be conferred if the officers themselves, upon arrival, would call at, or inform, the offices of the Empire Cotton Growing Corporation, which are at the corner of Millbank and Wood Street (entrance by the first door in Wood Street), immediately opposite the offices of the Crown Agents for the Colonies.

At the date of writing, the following officers are on leave or will shortly be arriving in England from cotton-growing countries:

Ceylon	Mr. J. C. Haigh.
Gold Coast	Mr. T. Hunter.
" "	Mr. C. W. Line.
" "	Mr. C. W. Lynn.
" "	Mr. A. C. Miles.
Kenya Colony	Mr. A. S. Hartley.
" "	Mr. A. C. Hunter.
" "	Mr. C. L. Silvester.
Nigeria	Mr. M. Greenwood.
"	Mr. J. G. Reynard.
"	Mr. J. Wallace.
"	Mr. J. F. Ward.
"	Mr. C. H. Wright.
Sierra-Leone	Mr. T. G. C. Squire.
Tanganyika	Mr. J. E. Bruce.
"	Mr. T. C. Cairns.
"	Mr. C. B. Garnett.
"	Mr. P. J. Greenway.
"	Mr. F. J. Nutman.
"	Mr. N. V. Rounce.
Uganda	Mr. H. Hargreaves.
"	Mr. J. D. Snowden.
"	Mr. R. T. Wickham.
West Indies	Mr. S. M. Gilbert.
" "	Mr. C. A. Gomez.
" "	Mr. A. E. S. McIntosh.
" "	Mr. F. Stell.

The following officers of the Corporation's staff abroad are on leave or will shortly be arriving in this country:

Northern Rhodesia	Mr. A. G. Bebbington.
Nyasaland	Mr. H. C. Ducker.
South Africa	Mr. F. R. Parnell.
Trinidad	Dr. T. G. Mason.

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